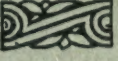


# PAGE'S WEEKLY



ENGINEERING · ELECTRICITY  
SHIPBUILDING  MINING  
IRON & STEEL INDUSTRIES

EDITORIAL & PUBLISHING OFFICES, CLUN HOUSE, SURREY STREET, STRAND, LONDON, W.C.

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GERMANY, Berlin : 13, Unter den Linden  
RUSSIA, St. Petersburg : 14, Nevsky Prospect.  
ITALY, Rome : 307 Corso.  
AUSTRIA, Vienna : Kärntnerstrasse, nr. 304

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# JOHN Z. THOM.



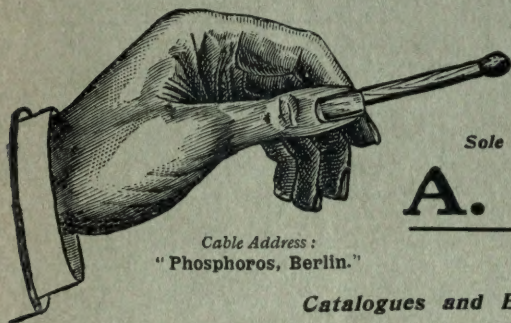
Why do you pay 9d. to 1/- per 1,000 gallons for water, when you can pump it for less than 1½d. from an Artesian Well on your own premises?

Let me know the amount of water you require and I shall be pleased to quote.

Telephone :  
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Telegrams :  
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*Sole Speciality since establishment in 1855 of*

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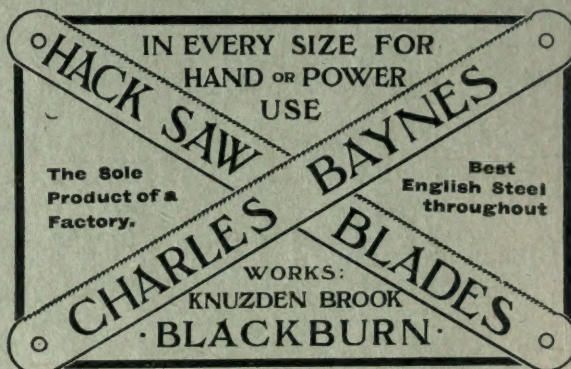
## PATENT PAPER PINIONS

FOR NOISELESS MOTOR DRIVES.

## MACHINE-CUT GEARS

OF ALL DESCRIPTIONS.

THE REID GEAR CO.,  
Linwood, PAISLEY.





# PAGE'S WEEKLY

## Miscellaneous

### Mr. G. H. HUGHES, M.I.Mech.E.,

Consulting and Organising Engineer for Water Works and Industrial Undertakings,

97, QUEEN VICTORIA ST., LONDON, E.C.

Telephone No.: 5754 Bank.

Write for particulars.

### ED. BRAND, MECHANICAL ENGINEER, 35, SHAKESPEARE STREET, MANCHESTER.

#### Modern Wire-Working Machinery.

Such as for Rolling, Drawing, Weaving, Netting, Forming, Automatic Straightening and Cutting, Cabling, Testing, &c.

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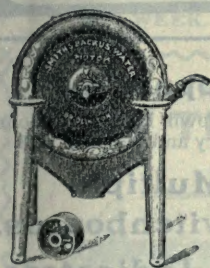
Telegr. Address: "Flieries, Manchester."

### J. FREDK. MELLING, 14, Park Row, LEEDS, ENGLAND.

Iron & Steel Bars, Plates, Sheets,  
Girders, Channels, Angles, Rails,  
Blooms, Billets, & Slabs.

Write for  
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and Prices.

Telegrams: "LEGATION, LEEDS."



#### CHEAP POWER.

SMITH'S

### Backus Water Motors

1/16 to 10 H.P.

Will drive any class of Machinery, and work on 15 lb. pressure.

ERIC S. A. SMITH, ENGINEER,  
APPLY FOR CATALOGUE. BRIDLINGTON.

**Our Modelled Designs TALK!**  
**We can prove it!**

**ARTHUR STAFFORD & CO.,**  
Catalogue and Half-Tone Printers,  
**Denton, MANCHESTER.**

See our Advertisements in last and next week's Issues.

JOSEPH BOOTH BROS., LTD.,  
RODLEY, LEEDS.

See next  
week.

### LIFTING MACHINERY.

THOS. W. WARD,  
ALBION WORKS,  
SHEFFIELD.

See Page  
17.

### MACHINE TOOLS.

THE SHANNON, LTD.,  
Ropemaker St., London, E.C.

See Page  
78.

### OFFICE APPLIANCES.

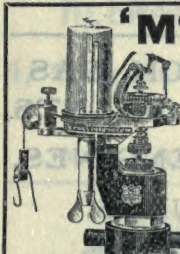
Have you seen our Advertisement on page 51. A glance at it may save you £500 per annum.—

ED. BENNIS & CO., Ltd., BOLTON.

### PAGE & ROWLINGSON, Chartered Patent Agents.

Mr. PAGE, who is a Whitworth Exhibitioner and an Associate Member of the Institute of Civil Engineers, has had a large experience as a Practical Mechanical Engineer, and is specially qualified to deal with the most intricate mechanical problems successfully. Write for Handbook of Information Free.

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And 14, St. Ann's Square, Manchester.



### 'McINNES-DOBBIE' INDICATORS.

In Two types: External and Enclosed Pressure Springs. Each made in several forms and sizes to suit all speeds and pressures. Special Indicators for Gas, Winding, and Ammonia Engines, and for Motor-Cars.

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Second Edition, Revised, Price 7s. 6d.

### DEPRECIATION OF FACTORIES, MINES, and Industrial Undertakings, and their Valuation. With Tables and Examples.

By EWING MATHESON, M.Inst.C.E.

The Principles which should guide the Writing off for wear and tear, Obsolete plant; Terminable or wasting properties; Effect on Income-tax; Value defined as for Compulsory purchase; Going concern, or dismantled; Rateable value, rental value.

"A successful attempt to systematise existing information and to make it possible to arrive at uniformity and accuracy in making up balance sheets for valuations. The work is unique of its kind."—The Engineer.

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### MARKS, STAMPS, BRANDING IRONS.

Sets of Letter and Figure Punches, Seals, Embossing Presses and Dies, Brass Name Plates, Stencil Plates, Moulders' Letters and Figures.

Brass Labels, and Time Checks.

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68, West Street, SHEFFIELD.

### WEST PASCAGOULA CREOSOTING WORKS,

WEST PASCAGOULA, MISS., U.S.A.

Situated on Pascagoula Bay and on the line of the Louisville and Nashville Railroad. These works have been in operation for more than twenty-six years. ORDERS for Creosoted Piles, Telegraph Poles, Cross Arms, Electric Conduits, Paving Blocks, Sawed Tiles, and Timber PROMPTLY EXECUTED. New cylinders, 115 ft. long. Capacity, one million feet per month. A.B.C. Code used. Cable address: Pierre, West Pascagoula, Miss.—Address, JNO. B. LINDSEY, Superintendent.



Contractors to H.M. Government.

### BRADBURY & CO., LTD.

Capstan  
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Saving Tools.



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# PAGE'S WEEKLY

## Miscellaneous



### Heating Apparatus BOILERS

Wrot Welded Iron and Cast Iron  
Sectional  
VERTICAL STEAM BOILERS

Apply for Catalogue.

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ENGINES AND GAS PLANTS,  
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"CAMPBELL" PUMPS.

SOLE MAKERS—

**THE CAMPBELL GAS ENGINE Co., Ltd.,**  
Halifax, England.

LONDON OFFICE—  
114, Tooley Street, S.E.

GLASGOW OFFICE—  
104, Bath Street.

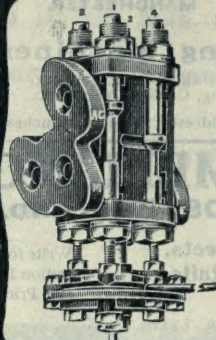


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Samples, Lists, and  
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350 lb. Steam  
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For High Pressure  
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PRICES AND  
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Illustr. Catalogues supplied to the TRADE only.

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For Domestic Use, Town Lines, and Long  
Distances, with Battery and Magneto Call.

Central and Multiple

... Switchboards.

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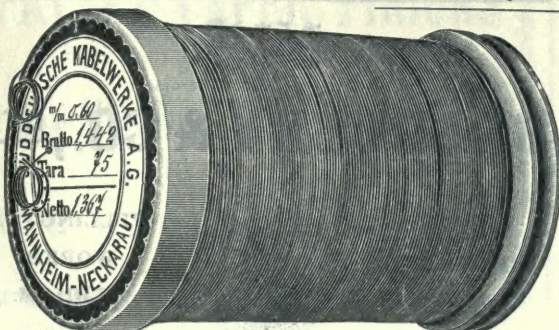
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**Silk-Covered  
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**TELEPHONE CABLES.**

With Paper and Air Insulation.

**LEAD COVERED CABLES**

For all Tensions up to 40,000 volts.



# PAGE'S WEEKLY

## Miscellaneous

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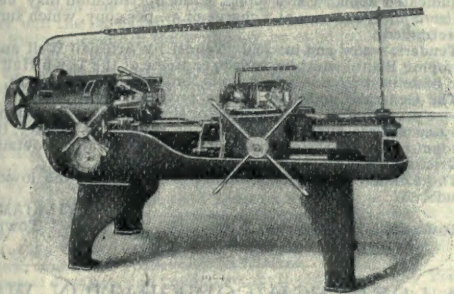
ZEITZ & Co., 21, Lime St., London, E.C.

**JOHN GIBBS & SON**  
Ventilating Engineers,  
80, JUKE STREET,  
LIVERPOOL.

*Say Advertising does not pay.*

SEE OUR ILLUSTRATED  
ADVERTISEMENT NEXT  
WEEK.

### HARTNESS FLAT TURRET LATHE



The only Turret Lathe with Cross-Sliding Head.

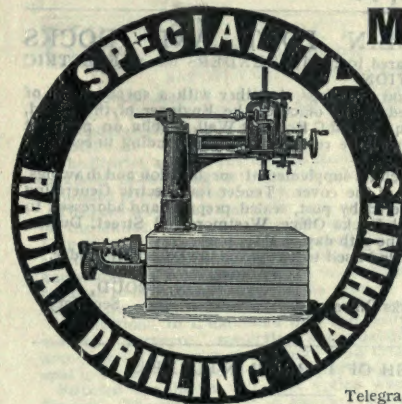
**JONES & LAMSON MACHINE CO.,**  
"JUBILEE BUILDINGS,"  
97, Queen Victoria Street, LONDON.

## Refuse Destructors.

Write for particulars to:-

**HEENAN & FROUDE, LIMITED,**  
4, Chapel Walks, MANCHESTER.

Works: MANCHESTER and WORCESTER.



### MACHINE TOOLS,

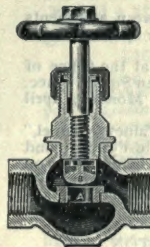
Special & General

For Engineers, Ship-builders, Boiler Makers, Girder Makers, and Bridge Builders.

**G. F. SMITH,**  
LIMITED,  
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### The "SHAW" Patent Steam Valves . .



With Renewable Seats, Interchangeable Concentric Valve, Compound Packing to Spindle, Special Metal, and High-Class Workmanship.

The "SHAW" Patent Parallel Slide Valve is the Acme of Simplicity and Durability.

**Try Them!** Sent on Approval.



Write for particulars of these and other Specialities for High Pressure Steam.

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## ARTHUR CORT & CO.,

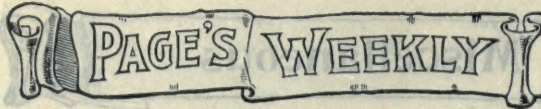
CAMBERWELL, LONDON, England.

MANUFACTURERS OF

**Vulcanised Fibre. Balata & Cotton Belting.**  
**Gutta Percha. Chatterton Compound.**

Telegrams: "CORT, CAMBERWELL, LONDON."





## Contracts

### CONTRACTS.

#### REFUSE DESTRUCTOR AND FLAG-MAKING PLANT. MUNICIPAL COUNCIL OF THE CITY OF SYDNEY, NEW SOUTH WALES.

The Municipal Council of the City of Sydney, New South Wales, invite TENDERS for the SUPPLY and ERECTION of SIX-CELL REFUSE DESTRUCTOR and for a FLAG-MAKING PLANT at Moore Park, within the City of Sydney, New South Wales.

Conditions of Contract, Specifications, and Tender Forms may be obtained on application to the Acting Agent-General for the State of New South Wales, Victoria Street, Westminster, S.W.

Tenders will be received up to Tuesday, May 30th, 1905, addressed to the Town Clerk, Town Hall, Sydney, New South Wales, endorsed "Tenders for Destructor and Flag Plant."

THOMAS H. NESBITT,

Town Clerk.

Town Clerk's Room, Town Hall, Sydney,  
February 9th, 1905.

#### THE DUBLIN PORT AND DOCKS GENERATING STATION.

Board is prepared to receive TENDERS for an ELECTRIC GENERATING STATION. The specification and drawings, together with a special form of Tender, can be obtained at the office of the Engineer of the Board, JOHN P. GRIFFITH, Esq., M.Inst.C.E., East Wall, Dublin, on payment of Five Pounds, which will be refunded to firms sending in *bona fide* Tenders.

Tenders, with contractor's supplemental specification and drawings, marked on the outside of the cover "Tender for Electric Generating Station," must be delivered by post, sealed prepaid, and addressed to the Secretary, Port and Docks Office, Westmoreland Street, Dublin, on or before Monday, the 15th day of May, 1905.

The Board does not bind itself to accept the lowest or any tender.

By order,

N. PROUD,

Secretary.

Dublin Port and Docks Office,  
April 3rd, 1905.

#### BOROUGH OF BARROW-IN-FURNESS.

##### TO CONTRACTORS.

#### THE CORPORATION OF BARROW-IN-FURNESS invite TENDERS for the CONSTRUCTION of a STEEL ROAD BRIDGE over the Walney Channel, uniting Barrow Island and Walney Island.

The Bridge will be about 1,123 ft. in total length between abutments and 50 ft. in width, and will consist of eight fixed girder spans, and one opening span, on cylinder foundations.

Drawings may be seen, and Specifications obtained, at the Office of the Engineer, Sir BENJAMIN BAKER, K.C.B., at 2, Queen Square Place, Queen Anne's Mansions, Westminster, on and after Monday, April 17th, 1905.

Sealed Tenders, endorsed "Tender for Bridge over Walney Channel," must be addressed to the Town Clerk of Barrow-in-Furness, and delivered at his Office, Town Hall, Barrow-in-Furness, before Noon on Monday, May 15th, 1905.

The Corporation does not bind itself to accept the lowest or any Tender.

By order,

C. F. PRESTON,

Town Clerk.

Town Hall, Barrow-in-Furness,  
April 8th, 1905.

#### BOROUGH OF KEIGHLEY.—The Electricity Committee is prepared to receive TENDERS for the following PLANT:—

##### CONTRACT No. 11.—SUPERHEATERS.

Specifications may be obtained from Mr. J. M. SMYTH, Borough Electrical Engineer, Electricity Works, on payment of One Guinea for each specification to Mr. ALFRED LISTER, Borough Treasurer, Town Hall, which fee will be returned on receipt of a *bona fide* Tender.

Extra copies may be had for 5s. each, which sum will not be returned.

Sealed Tenders, endorsed "Contract No. 11," and addressed to the Chairman of the Electricity Committee, Town Hall, must be delivered not later than 10 a.m. on Saturday, May 20th, 1905.

The Corporation do not bind themselves to accept the lowest or any Tender.

By order,

GEORGE BURR,

Town Clerk.

Town Hall, Keighley,  
May 1st, 1905.

#### FEDERATED MALAY STATES. JOHORE STATE RAILWAYS.

##### TENDERS FOR PERMANENT WAY MATERIALS.

#### THE CROWN AGENTS FOR THE COLONIES, acting on behalf of the Government of the Federated Malay States, invite TENDERS from manufacturers, as follows:—

- (1) About 7,783 TONS of STEEL RAILS (80 lb.) and 681 TONS FISH-PLATES, and
- (2) About 73 TONS FISH-BOLTS and NUTS and 185 TONS DOG-SPIKES.

Specifications and conditions of contract can be obtained at the office of the Crown Agents for the Colonies, Whitehall Gardens, S.W., on and after Monday, May 1st, 1905, between the hours of 10 a.m. and 4 p.m. (Saturdays 10 to 1).

A charge of £1 will be made for each specification.

This sum will be returned to each person or firm submitting a *bona fide* Tender properly completed in all respects within the time specified below.

Tenders to be delivered in sealed envelopes, addressed to the Crown Agents for the Colonies, Whitehall Gardens, S.W., not later than noon, May 17th, endorsed "Tenders for Permanent Way Materials."

The Crown Agents do not bind themselves to accept the lowest or any Tender.

#### METROPOLITAN BOROUGH OF HACKNEY.

##### ELECTRICITY WORKS.

The COUNCIL of the Metropolitan Borough of Hackney are prepared to receive TENDERS for the FOLLOWING:—

##### SPECIFICATION No. 24.—Artesian Well and Air-Lift Pumping Plant.

General Conditions, Specification, Drawings, Form of Tender, and Form of Agreement may be inspected at the Offices of Mr. ROBERT HAMMOND, M.Inst.C.E., the Consulting Engineer to the Council, 64, Victoria Street, Westminster, S.W., and may be obtained there on or after Friday, May 5th, 1905, on making a deposit of £5, which sum will be refunded to *bona fide* Tenderers after the Tenders have been adjudicated upon. Extra copies of the Specification may be obtained by *bona fide* Tenderers at a charge of 5s. per copy, which sum will not be refunded.

Tenders, sealed and marked "Tender for Artesian Well and Air-Lift Pumping Plant," must be addressed to me at the Town Hall Hackney, and be delivered on or before 4 p.m. on Thursday, May 25th, 1905.

The General Conditions of the proposed Contract will contain a clause providing that the Contractor shall pay to all workmen wages at rates not less, and observe hours of labour not greater, than those recognised by the various trade unions and in practice obtained in the district where the work is produced or executed.

The Council do not bind themselves to accept the lowest or any Tender.

Town Hall, Hackney,  
May 4th, 1905.

W. A. WILLIAMS,

Town Clerk.

#### ALDEBURGH CORPORATION WATER.

##### CONTRACT No. 2.—NEW ENGINE-HOUSE, RISING MAIN, &c.

##### TO BUILDERS AND CONTRACTORS.

The Corporation of Aldeburgh are prepared to receive TENDERS from competent persons willing to enter into a Contract for the CONSTRUCTION of a NEW ENGINE-HOUSE at the Well near Aldeburgh Hall Farm, together with about 870 lineal yards of CAST-IRON PIPES, 6 inches diameter, from the Engine-House to the existing Water-Tower, including Valve Chambers, Machinery Foundations, and other Works connected therewith.

The Drawings may be seen and copies of the Specification and Bills of Quantities may be obtained, at and after noon of Monday, May 1st, at the Office of the Borough Surveyor, Mr. J. C. GORDON, Aldeburgh, or at the Office of the Engineers, Messrs. JAMES MANSENG AND SONS, 5, Victoria Street, Westminster, on the deposit of Two Guineas, which will be returned after the receipt of a *bona fide* Tender with the Quantities fully priced out.

Early application for particulars is desirable, as only a limited number will be given out.

Sealed Tenders, endorsed "Tender for Engine-House, &c.," are to be delivered at my office on or before noon of Friday, May 24th, 1905.

The Corporation do not bind themselves to accept the lowest or any Tender.

HENRY C. CASLEY,

Town Clerk.

Aldeburgh, April 29th, 1905.



# PAGE'S WEEKLY

## Contracts

### ALDEBURGH CORPORATION WATER.

#### CONTRACT No. 3. PUMPING MACHINERY.

The Corporation of Aldeburgh are prepared to receive TENDERS from competent Engine Builders and Machinists for the MAKING, ERECTING, SETTING to WORK and MAINTAINING in GOOD ORDER for Three Months, at the New Well, near Aldeburgh Hall Farm, of TWO "HORNSBY-ACKROYD" CHEAP FUEL OIL ENGINES, TWO "HAYWARD-TYLER" UNIVERSAL PATTERN PUMPS, with all necessary Gearing, Shafting, Pipes, Valves, and other Fittings.

The Drawings may be seen and Copies of the Specification and Bill of Particulars may be obtained at and after noon of Monday, May 1st, at the office of the Borough Surveyor, Mr. J. C. GORDON, Aldeburgh, or at the Office of the Engineers, Messrs. JAMES MANSENG AND SONS, 5, Victoria Street, Westminster, on the deposit of Two Guineas, which will be returned after the receipt of a *bona fide* Tender with the Bill of Particulars fully priced out.

Early application for particulars is desirable, as only a limited number will be given out.

Sealed Tenders, endorsed "Tender for Pumping Machinery," are to be delivered at my office on or before noon of Friday, May 24th, 1905. The Corporation do not bind themselves to accept the lowest or any Tender.

HENRY C. CASLEY,  
Town Clerk.

Aldeburgh, April 29th, 1905.

#### COUNTY OF LONDON.

#### TO MAKERS OF STORAGE BATTERIES AND OTHERS.

**THE LONDON COUNTY COUNCIL** invites TENDERS for the SUPPLY, ERECTION at its GENERATING STATION, East Greenwich, S.E., and MAINTENANCE, for a period of ten years of a BATTERY of 280 ACCUMULATOR CELLS having capacities of 645 ampere-hours at a three-hour discharge rate, and of 450 ampere-hours at a one-hour discharge rate.

Persons desiring to submit Tenders may obtain the Specifications, Drawings, Bills of Quantities, Form of Tender, and other particulars at the County Hall, Spring Gardens, S.W., upon payment to the Cashier of the Council of the sum of £2. This amount will, after the Council or its Committee have come to a decision upon the Tenders received, but not before, be returned to the tenderer, provided he shall have sent in a *bona fide* Tender, and not have withdrawn the same, but in no case will the fee be returned unless a *bona fide* Tender is submitted. Full particulars of the work may be obtained on application at the County Hall, previously to the payment of the fee for the Specification, etc. Tenders must be upon the official forms, and the printed instructions contained therein must be strictly complied with. The contractors will be bound by the contract to pay all workmen (except a reasonable number of legally bound apprentices) employed by them, wages at rates not less, and to observe hours of labour not greater than the rates and hours set out in the Council's list, and such rates of wages and hours of labour will be inserted in and form part of the contract by way of schedule. Each Tender is to be delivered at the County Hall, in a sealed cover, addressed to the Clerk of the London County Council, Spring Gardens, S.W., and marked "Tender for Accumulators." No Tender will be received after 10 a.m. on Tuesday, the 16th day of May, 1905. Any Tender which does not comply with the printed instructions for Tender may be rejected.

The Council does not bind itself to accept the lowest or any Tender, and it will not accept the Tender of any person or firm who shall on any previous occasion have withdrawn a Tender after the same had been opened, unless the reasons for the withdrawal were satisfactory to the Council.

G. L. GOMME,  
Clerk of the London County Council.

County Hall, Spring Gardens, S.W.,  
April 19th, 1905.

### THE SOUTH INDIAN RAILWAY COMPANY, LIMITED, is prepared to receive TENDERS for the SUPPLY of—

- (a) STEEL BRIDGES, 10 ft. to 55 ft. spans, about 1,800 tons.  
(b) " " 20 ft. to 40 ft. " " 83 "

Specifications and forms of Tender may be obtained at the Company's Offices on and after Monday, May 1st.

Tenders, addressed to the Chairman and Directors of the South Indian Railway Company, Limited, and marked "Tender for Bridges," must be left with the undersigned not later than 12 noon of Tuesday, May 16th, 1905.

The Company is not bound to accept the lowest or any Tender.

A charge, which will not be returned, will be made of 20s. for each copy of specification (a), and of 10s. for each copy of (b).

Copies of the drawings may be obtained at the office of Sir GEORGE B. BRUCE, 3, Victoria Street, Westminster, on payment of 5s. per sheet.

By order,

HENRY W. NOTMAN,  
Managing Director.

Company's Offices,  
55, Gracechurch Street, London, E.C.,  
April 28th, 1905.

### APPOINTMENTS OPEN.

#### UNIVERSITY OF BIRMINGHAM. FACULTY OF SCIENCE.

##### PROFESSORSHIP OF CIVIL ENGINEERING.

The Council of the University wish to ELECT a PROFESSOR of CIVIL ENGINEERING to CO-OPERATE with the PROFESSORS of MECHANICAL and ELECTRICAL ENGINEERING. He will have charge, with an assistant, of the teaching of Surveying, Strength of Materials, Hydraulics, and other branches of Civil Engineering, and will superintend the Laboratories for Hydraulics and Strength of Materials.

The stipend will be £600 a year.

The Professor will be allowed to take higher consultative work, to keep in touch with Civil Engineering practice, provided that it does not interfere with his University duties.

Applications, accompanied by seventy-five copies of testimonials, should be received by the Secretary not later than May 20th.

The successful candidate will be expected to begin his duties on October 2nd, 1905.

Further particulars may be obtained from

GEO. H. MORLEY,  
Secretary.

#### URBAN DISTRICT COUNCIL OF BEESTON.

##### APPOINTMENT OF SURVEYOR.

The above-named Council invite APPLICATIONS for the post of SURVEYOR and SANITARY INSPECTOR in their district at a commencing salary of £150 a year. An office will be provided by the Council.

The district adjoins the City of Nottingham, and comprises an area of about 1,600 acres, with a road mileage of 22 miles, and has an estimated population of over 11,000.

The person appointed must be fully qualified to perform the whole of the duties appertaining to the office of Surveyor and Sanitary Inspector to an Urban District Council, to prepare plans, quantities, specifications, and estimates for works, and must have a thorough knowledge of the construction and maintenance of roads. He will be required to devote the whole of his time to the duties of his office, keep all necessary books and accounts, and reside within the district.

Applications, in Candidate's own handwriting, in sealed envelope, marked "Surveyor," specifying age, qualifications, and experience, accompanied by copies of not more than three testimonials, must be sent to me on or before the 10th day of May, 1905.

Selected Candidates will have notice when to attend before the Council. The appointment of Sanitary Inspector will be subject to the approval of the Local Government Board.

Canvassing after this advertisement will be a disqualification.

Dated April 20th, 1905.

W. H. REDGATE, Solicitor,  
Clerk to the Council.

Bentnick Buildings, Wheeler Gate, Nottingham.

#### JOHANNESBURG MUNICIPAL ELECTRIC TRAMWAYS.

##### LIGHTING AND POWER UNDERTAKING.

The Town Council invites APPLICATIONS from persons having suitable experience for the following APPOINTMENTS, under three years' agreements.

The successful candidates will be required to devote their whole time to the Council's service.

Each application should be accompanied by a brief description of the applicant's training and experience and by suitable references.

Applicants should be prepared to take up their duties about the beginning of August next.

(A) A GENERAL MANAGER, to take charge of the entire tramway, lighting and power undertakings.

It is desirable that applicants should be engineers, but good business capacity and experience in tramway management are essential.

Gas engine and producer experience, if any, should be defined.

Salary, £2,000 per annum.

Half salary will be allowed from date of sailing to arrival in Johannesburg, but no travelling expenses.

Applications, clearly endorsed "(A) General Manager," are to be addressed to Messrs. MORDEY AND DAWBARN, 82, Victoria Street, Westminster, S.W., and must be received by them not later than the first post on Monday, May 20th next.

(B) A STATION ENGINEER to take charge of the generating station and tramway workshops.

The station comprises gas producers, gas engines, direct-current and alternate-current generators of 13,000 B.H.P. capacity.

Experience with gas engines and producers' is essential, and of both direct and alternate-current plant is desirable.

Salary, £1,000 per annum with house free.

Half salary will be allowed from date of sailing to arrival in Johannesburg.

Applications, clearly endorsed "(B) Station Engineer," are to be addressed to Messrs. MORDEY AND DAWBARN, 82, Victoria Street, Westminster, S.W., and must be received by them not later than the first post on Monday, May 29th next.

May 3rd, 1905.



# BUYERS' DIRECTORY.

*NOTE.—The display advertisements of the firms mentioned under each heading can be found readily by reference to the Alphabetical Index to Advertisers on pages 35, 37, 38, and 40.*

*In order to assure fair treatment to advertisers, each firm is indexed under its leading speciality ONLY.*

*Advertisers who prefer, however, to be entered under two or more different sections can do so by an annual payment of 5s. for each additional section.*

## Artesian Well Machinery.

John Z. Thom, Patricroft, Manchester.

## Belting.

Binney & Son, Catherine Street, City Road, London, E.C.  
Cort, Arthur, & Co., Camberwell, London, S.E.  
Fleming, Birkby & Goodall, Ltd., West Grove, Halifax.  
Gilmour, W. & O., St. John's Hill, Edinburgh.

## Boilers.

Clayton, Son & Co., Ltd., Leeds City Boiler Works, Leeds.  
Grantham Crank & Iron Co., Ltd., Grantham.  
Hartley & Sugden, Ltd., Halifax.

## Boilers (Water-tube).

Babeock & Wilcox, Ltd., Oriel House, Farringdon Street, London, E.C.  
Stirling Boiler Co., Ltd., Motherwell, N.B.

## Bolts, Nuts, Rivets, etc.

Herbert W. Periam, Ltd., Floodgate Street Works, Birmingham.  
T. D. Robinson & Co., Ltd., Derby.

## Books.

Crosby Lockwood & Son, Stationers' Hall Court, London, E.C.  
Griffin, Charles, & Co., Exeter Street, Strand, W.C.  
New Zealand Mines Record, Wellington, New Zealand.  
Spon, E. & F. N., 125, Strand, W.C.  
World's Work and Play.

## Boring Machines.

Asquith, William, Ltd., Well Road Works, Halifax.

## Cables.

St. Helen's Cable Co., Ltd., Warrington, Lancashire.

## Case-Hardening Compounds.

Hy. Miller & Co., Millgate Works, Leeds.

## Castings.

Ashmore, Benson, Pease & Co., Ltd., Stockton-on-Tees.

## Catalogues, Printing, &c.

Atlantic Press, Ltd., Weymouth Street, Manchester.  
Southwood, Smith & Co., Ltd., Plough Court, Fetter Lane, London, E.C.  
Spottiswoode Advertising Agency, 8, New Street Square, E.C.  
Stafford, Arthur, & Co., Denton, Manchester.

## Chucks.

Faithbanks Co., 78-80, City Road, London, E.C.

## Cisterns, Tanks, &c.

Ashmore, Benson, Pease & Co., Ltd., Stockton-on-Tees.  
F. A. Keep, Juxon & Co., Barn Street, Birmingham.

## Clutches (Friction).

David Bridge & Co., Castleton Ironworks, Rochdale, Lancashire.

## Colliery Plants.

Graham, Morton & Co., Ltd., Leeds.

## Condensing Plant.

Benn, Sykes, Haslingden, near Manchester.  
Concentric Condenser, Ltd., 23, Northumberland Avenue, London, W.C.  
Mirrieles-Watson & Co., Ltd., Glasgow.

## Consulting Engineers.

Gibbs, John, & Son, 80, Juke Street, Liverpool.  
G. H. Hughes, A.M.I.M.E., 97, Queen Victoria Street, London, E.C.  
Melville & Macalpine, 615, Walnut Street, Philadelphia, Pa., U.S.A.

## Continental Railway Arrangements.

South Eastern & Chatham Railway Co.

## Conveying and Elevating Machinery.

Adolf Bleichert & Co., Leipzig-Gohlis, Germany.  
Fraser & Chalmers, Ltd., 3, London Wall Buildings, London, E.C.  
Graham, Morton & Co., Ltd., Leeds.  
Temperley Transporter Co., 72, Bishopsgate Street Within, London, E.C.

## Coverings (Boiler).

Magnesia Coverings, Ltd., Washington Station, co. Durham.

## Cranes, Travellers, Winches, etc.

Joseph Booth & Bros. Ltd, Rodley, Leeds.  
Thomas Broadbent & Sons, Ltd., Huddersfield.  
Niles-Bement Pond Co., 23-25, Victoria Street, London, S.W.

## Cranks.

Clarke's Crank & Forge Co., Ltd., Lincoln, England.

## Cutters (Milling).

E. G. Wrigley & Co., Ltd., Foundry Lane Works, Soho, Birmingham.

## Destructors.

Heenan & Froude, 4, Chapel Walks, Manchester.  
Horsfall Destructor Co., Ltd., Armley, Leeds.

## Dredges and Excavators.

Delange & Cie, Mce., Hoboken, near Antwerp.  
Rose, Downs & Thompson, Ltd., Old Foundry, Hull.

## Drilling Machines.

Asquith, William, Ltd., Well Road Works, Halifax.  
Swift, George, Claremont Ironworks, Halifax.

## Economisers.

E. Green & Son Ltd., Manchester.

## Ejectors (Pneumatic).

Hughes & Lancaster, 47, Victoria Street, London, S.W.

## Electrical Apparatus.

Allgemeine Elektrizitäts Gesellschaft, Berlin, Germany.  
Broadbent, T. W., Victoria Electrical Works, Huddersfield.  
Crypto Electrical Co., 3, Tyer's Gateway, Bermondsey Street, London, S.E.  
Gent & Co., Ltd., Faraday Works, Leicester.  
Greenwood & Batley, Ltd., Albion Works, Leeds.  
India Rubber, Gutta Percha, and Telegraph Works Co., Ltd., The Silvertown, London, E.  
Mather & Platt, Ltd., Salford Iron Works, Manchester.  
Matthews & Yates, Ltd., Swinton, Manchester.  
Mix and Genest, Berlin, W., Germany.  
Nalder Bros. & Thompson, 34, Queen Street, London, E.C.  
Newton Brothers, Full Street, Derby.  
Phoenix Dynamo Manufacturing Co., Bradford, Yorks.  
Sturtevant Engineering Co., Ltd., 147, Queen Victoria Street, London, E.C.  
Turner, Atherton & Co., Ltd., Denton, Manchester.  
B. Weaver & Co., 22, Rosoman Street, Clerkenwell, London, E.C.

## Engineers' Supplies.

Ahlers, Ad., Whitley Pay, near Newcastle-on-Tyne.

## Engines (Gas).

Campbell Gas Engine Co., Ltd., Halifax.  
Soest, L., & Co., Ltd., 114-116, Victoria Street, London, S.W.

## Engines (Electric Lighting).

McLaren, J. and H., Midland Engine Works, Leeds.

## Engines (Locomotive).

Baldwin Locomotive Works, Philadelphia, Pa., U.S.A.  
Hunslet Engine Co., Ltd., Leeds, England.  
Hudswell, Clarke & Co., Ltd., Leeds, England.  
McLaren, J. & H., Midland Engine Works, Leeds.

## Engines (Portable).

Garrett, R., & Sons, Leiston, R.S.O., Suffolk.

## Engines (Stationary).

Allis-Chalmers Co., 533, Salisbury House, Finsbury Circus, London, E.C.  
Fraser & Chalmers, Ltd., 3, London Wall Buildings, London, E.C.  
Garrett, R., & Sons, Leiston, R.S.O., Suffolk.  
Mirrieles Watson Co., Ltd., Glasgow.

## Engines (Traction).

Jno. Fowler & Co. (Leeds), Ltd., Steam Plough Works, Leeds.  
Garrett & Sons, Ltd., Richard, Leiston, R.S.O., Suffolk.

## Engravers.

Jno. Swain & Son, Ltd., 58, Farringdon Street, London, E.C.

## Exhaust Steam Oil Separators.

Lancaster & Tonge, Ltd., Pendleton, Manchester.

## Fans, Blowers.

Capel Fan Co., 13, Moseley Street, Newcastle-on-Tyne.  
Davidson & Co., Ltd., "Sirocco" Engineering Works, Belfast, Ireland.  
Gibbs, John & Son, 80, Juke Street, Liverpool.  
James Keith & Blackman Co., Ltd., 27, Farringdon Avenue, London, E.C.  
Matthews & Yates, Ltd., Swinton, Manchester.

## Fire Bricks.

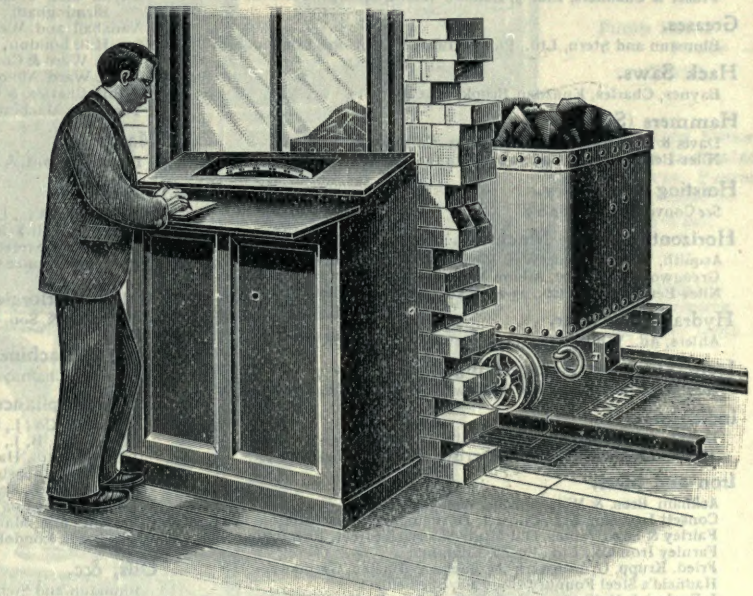
J. H. Sankey & Son, Ltd., Essex Wharf, Canning Town, London, E.



# PAGE'S WEEKLY Weighing Machinery



FOR THE RAPID  
WEIGHING OF  
TRAINS OF  
LOADED TRUCKS.



### AVERY'S PATENT

Automatic Self-Indicating

## Colliery Weighing Machine

For COLLIERIES, QUARRIES, etc.

*The Actual Net Weight is Indicated Automatically by the Machine itself.*



## Buyers' Directory—(Continued).

### Firewood Machinery.

M. Glover & Co., Patentees and Saw Mill Engineers, Leeds.

### Fountain Pens.

Mabie, Todd & Bard, 93, Cheapside, London, E.C.

### Forging (Drop) Plants.

Brett's Patent Lifter Co., Ltd., Coventry.

### Forgings (Drop).

J. H. Williams & Co., Brooklyn, New York, U.S.A.

### Furnaces.

Deighton's Patent Flue & Tube Company, Vulcan Works, Pepper Road, Leeds.

Leeds Forge Co., Ltd., Leeds.

W. F. Mason, Ltd., Engineers, Manchester.

### Gas Producers.

Graham, Morton & Co., Ltd., Leeds.

W. F. Mason, Ltd., Engineers, Manchester.

### Gauge Glasses.

J. B. Treasure & Co., Vauxhall Road, Liverpool.

Tomey, J., & Sons, Aston, Birmingham.

### Gearing.

Ahlers, Ad., Whitley Bay, near Newcastle-on-Tyne.

Asquith, William, Ltd., Well Road Works, Halifax.

Hamilton & Co., J. B., 145, Cannon Street, E.C.

Reid Gear Co., Linwood, near Glasgow.

Wild, M. B., & Co., Corporation Street, Birmingham.

### Gold Dredging Plant.

Fraser & Chalmers, Ltd., 3, London Wall Buildings, London, E.C.

### Greases.

Blumann and Stern, Ltd., Plough Bridge, Deptford, London, S.E.

### Hack Saws.

Baynes, Charles, Knuzden Brook, Blackburn.

### Hammers (Steam).

Davis & Primrose, Leith Ironworks, Edinburgh.

Niles-Bement Pond Co., 23-25, Victoria Street, London, S.W.

### Hoisting Machinery.

See Conveying Machinery.

### Horizontal Boring Machines.

Asquith, William, Ltd., Well Road Works, Halifax.

Greenwood & Batley, Albion Works, Leeds.

Niles-Bement Pond Co., 23-25, Victoria Street, London, S.W.

### Hydraulic Leather.

Ahlers, Ad., Whitley Bay, near Newcastle-on-Tyne.

### Icemaking and Refrigerating Machinery.

H. J. West & Co., 114-118, Southwark Bridge Road, London, S.E.

### Indicators.

Dobbie McInnes, Ltd., 41 & 42, Clyde Place, Glasgow.

Hannan & Buchanan, 75, Robertson Street, Glasgow.

### Iron and Steel.

Askham Bros. & Wilson, Ltd., Sheffield.

Consett Iron Co., Ltd., Consett, Durham, and Newcastle-on-Tyne.

Fairley & Sons, James, Old Mint, Shadwell Street, Birmingham.

Farnley Iron Co., Ltd., Leeds, England.

Fried. Krupp, Grusonwerk, Magdeburg-Buckau, Germany.

Hadfield's Steel Foundry Co., Ltd., Sheffield.

J. Frederick Melling, 14, Park Row, Leeds, England.

Parker Foundry Co., Derby.

Purden, John & Sons, Lambhill Forge, by Maryhill Glasgow.

Walter Scott, Ltd., Leeds Steel Works, Leeds, England.

Gilbert Thompson & Co., 116, Victoria Street, London, S.W.

### Ironwork (Constructional).

F. A. Keep, Juxon & Co., Farn Street, Birmingham.

### Ironwork (Galvanised).

F. A. Keep, Juxon & Co., Barn Street, Birmingham.

### Lagging Sheets.

Zeitz & Co., 21, Lime Street, London, E.C.

### Lathes.

Asquith, William, Ltd., Well Road Works, Halifax.

Bradbury & Co., Ltd., Wellington Works, Oldham.

Eclipse Tool Manufacturing Co., Linwood, near Glasgow.

Leckenby, Benton, & Co., Perseverance Ironworks, Halifax.

Mitchell, D., & Co., Ltd., Central Ironworks, Lawkholme, Keighley.

Northern Engineering Co. (1900) Ltd., King Cross, near Halifax.

Swift, George, Claremont Ironworks, Halifax.

### Lathe Carriers.

Williams, J. H., & Co., Brooklyn, New York, U.S.A.

### Laundry Machinery.

W. Summerscales & Sons, Ltd., Engineers, Phoenix Foundry, Keighley, England.

### Lifts.

Waygood & Co., Ltd., Falmouth Road, London, S.E.

### Lubricants.

Blumann & Stern, Ltd., Plough Bridge, Deptford, London, S.E.

Reliance Lubricating Oil Co., The, 19 & 20, Water Lane, Great Tower Street, London, E.C.

Matthew Wells & Co., Hardman Street Oil Works, Manchester.

### Machine Tools.

Asquith, William, Ltd., Well Road Works, Halifax.

George Addy & Co., Waverley Works, Sheffield.

Bateman's Machine Tool Co., Hunslet, Leeds.

Bertrams, Ltd., St. Katherine's Works, Sciennes, Edinburgh.

Bradbury & Co., Ltd., Wellington Works, Oldham.

Breuer, Schumacher & Co., Ltd., Kalk, near Cologne-on-Rhine (Germany).

Cunliffe & Croom, Ltd., Broughton Ironworks, Manchester.

Dean, Smith & Grace, Ltd., Keighley.

Greenwood & Batley, Ltd., Leeds.

Jones & Lamson Machine Co., 97, Queen Victoria Street, London, E.C.

John Lang & Sons, Johnstone, near Glasgow.

Luke & Spencer, Ltd., Broadheath, Manchester.

Mitchell, D., & Co., Ltd., Central Ironworks, Lawkholme, Keighley.

Jos. C. Nicholson Tool Co., City Rd. Tool Wks., Newcastle-on-Tyne.

Niles-Bement-Pond Co., 23-25, Victoria Street, London, S.W.

Noble & Lund, Ltd., Felling-on-Tyne.

Northern Engineering Co., 1900, Ltd., King Cross, near Halifax.

J. Parkinson & Son, Canal Ironworks, Shipley, Yorkshire.

C. Redman & Sons, Halifax.

Rice & Co. (Leeds), Ltd., Leeds, England.

G. F. Smith, Ltd., South Parade, Halifax.

Swift, George, Claremont Ironworks, Halifax.

Taylor and Challen, Ltd., Derwent Foundry, Constitution Hill, Birmingham.

Vauxhall and West Hydraulic Engineering Co., Ltd., 23, College Hill, London, E.C.

H. W. Ward & Co., Lionel Street, Birmingham.

T. W. Ward, Albion Works, Sheffield.

Winn, Charles, & Co., St. Thomas Works, Birmingham.

Yorkshire Machine Tool and Engineering Works, Liversedge, Yorks.

### Marks.

Pryor, Edward, & Son, 68, West Street, Sheffield.

### Metals.

Delta Metal Co., Ltd., 110, Cannon Street, London, E.C.

Magnolia Anti-Friction Metal Co., Ltd., of Great Britain, 49, Queen Victoria Street, London, E.C.

Phosphor Bronze Co., Ltd., Southwark, London, S.E.

### Metals (Perforated).

W. Barns & Son, Chalton Street, Euston Road, London, N.W.

### Mining Machinery.

Fraser & Chalmers, Ltd., 3, London Wall Buildings, London, E.C.

### Office Appliances.

Halden & Co., J., 8, Albert Square, Manchester.

Hall & Co., E. J., 39, Victoria Street, London, S.W.

Lyle Co., Ltd., Harrison Street, Gray's Inn Road, London, W.C.

Rockwell-Wabash Co., Ltd., 69, Milton Street, London, E.C.

Shannon, Ltd., Ropemaker Street, London, E.C.

Titan Binder Co., 31, Queen Victoria Street, London, E.C.

Trading and Manufacturing Co., Ltd., Temple Bar House, Fleet Street, London, E.C.

### Oils, &c.

Blumann and Stern, Ltd., Plough Bridge, Deptford, London, S.E.

Valor Co., Ltd., Rocky Lane, Aston Cross, Birmingham.

Wells, M., & Co., Hardman Street Oil Works, Manchester.

### Packing.

Beldam Packing & Rubber Co., 93-94, Gracechurch Street, London, E.C.

Frictionless Engine Packing Co., Ltd., Hendham Vale Works, Harpurhey, Manchester.

Lancaster & Tonge, Ltd., Pendleton, Manchester.

Redfern & Co., S., Swan Lane, New Brown Street, Manchester.

Quaker City Rubber Co., Coronation House, Lloyd's Avenue, E.C.

United Kingdom Self-Adjusting Anti-Friction Metallic Packing

Syndicate, 14, Cook Street, Liverpool.

United States Metallic Packing Co., Ltd., Bradford,

J. Bennett von der Heyde, 6, Brown Street, Manchester.

### Paint (Metallic).

Metallic Paint Co., Ltd., Cardiff.

### Paper.

Lepard & Smiths, Ltd., 29, King Street, Covent Garden, London, W.C.

### Patent Agents.

Page & Rowlingston, 28, New Bridge Street, London, E.C.



PAGE'S WEEKLY Pumping Machinery

# Pumping Machinery

FOR WATERWORKS AND MINES.

## Official

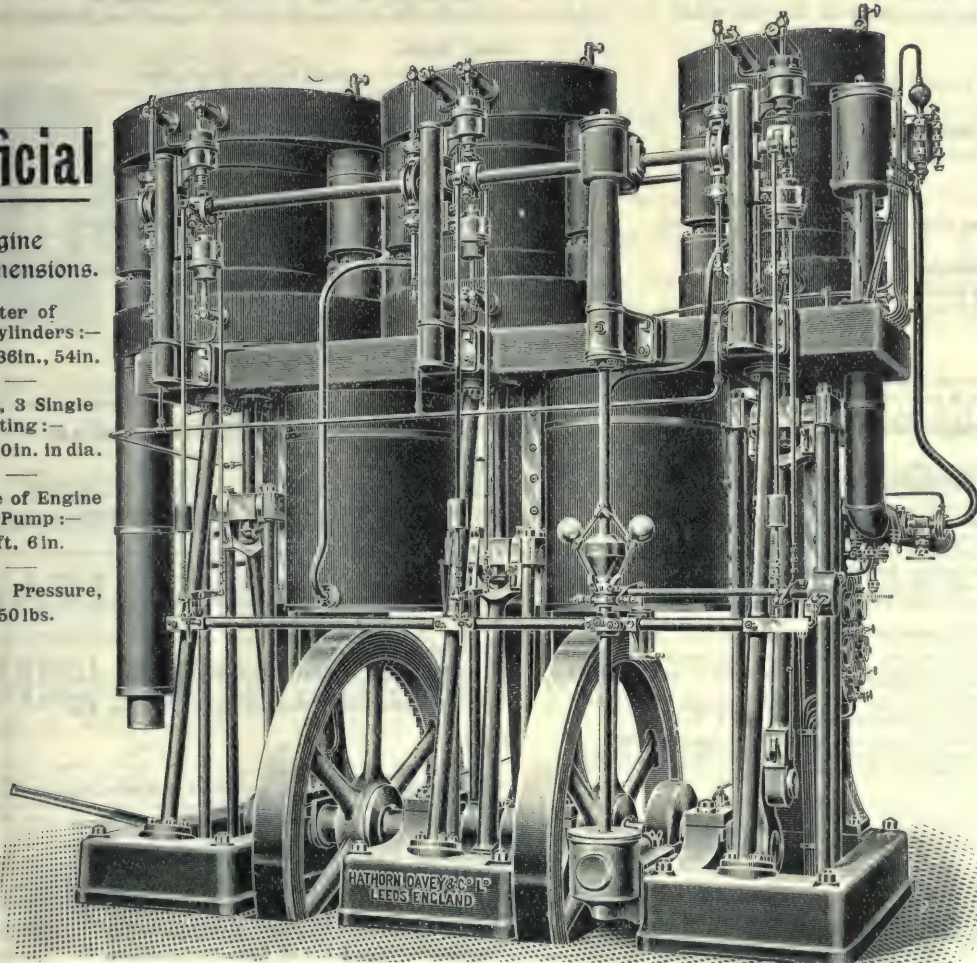
### Engine Dimensions.

Diameter of  
Cylinders:—  
20in., 36in., 54in.

Rams, 3 Single  
Acting:—  
Each 30in. in dia.

Stroke of Engine  
and Pump:—  
3 ft. 6in.

Steam Pressure,  
150lbs.



## Trial.

### Engine Results.

Pump Horse  
Power —  
274·55.

Saturated Steam  
per Indicated  
Horse Power  
per hour:—  
12·4 lbs.

Mechanical  
Efficiency —  
92·8 per cent.

Contract Duty to raise 6,240 Gallons of sewage per minute 125 feet high.

*Triple Expansion Sewage Pumping Engine, Melbourne and Metropolitan Board of Works.*

# HATHORN, DAVEY & CO.,

LIMITED.

Codes Used:  
A.B.C. 4th Edition.  
Universal Mining Code.

## LEEDS, England.

Telegrams:  
"HATHORN, LEEDS"



## Buyers' Directory—(Continued).

### Photo Copying Frames.

J. Halden & Co., 8, Albert Square, Manchester.  
B. J. Hall & Co., 39, Victoria Street, London, S.W.

### Photographers.

Booker & Sullivan, 67 and 69, Chancery Lane, W.C.  
Elliott & Fry, 55, Baker Street, London, W.

### Pinch Bars.

Samson & Co., Garforth, near Leeds.

### Pipe Wrenches (Chain).

Williams, J. H., & Co., Brooklyn, New York, U.S.A.

### Pistons.

Lancaster & Tonge, Ltd., Pendleton, Manchester.

### Planished Sheets.

Zeitz & Co., 21, Lime Street, London, E.C.

### Porcelain.

Gustav Richter, Charlottenburg, near Berlin, Germany.

### Presses (Hydraulic).

Greenwood & Batley, Albion Works, Leeds.  
Niles-Bement-Pond Co., 23-25, Victoria Street, London, S.W.

### Publishers.

Crosby Lockwood & Son, 7, Stationers' Hall Court, London, E.C.  
Charles Griffin & Co., Ltd., Exeter Street, Strand, London, W.C.  
Spon, E. and F. N., 125, Strand, W.C.  
New Zealand Mines Record, Wellington, New Zealand.

### Pumps and Pumping Machinery.

Drum Engineering Co., 27, Charles Street, Bradford.  
Enke, Carl, Schkeuditz-Leipzig, Germany.  
Fairbanks, Morse & Co., 126, Southwark Street, London, S.E.  
Fraser & Chalmers, Ltd., 3, London Wall Buildings, London, E.C.  
J. P. Hall & Sons, Ltd., Peterborough.  
Hathorn, Davey & Co., Ltd., Leeds, England.  
Positive Rotary Pumps, Ltd., 23, Northumberland Avenue, London, W.C.  
Tangyes, Ltd., Cornwall Works, Birmingham.

### Radial Drilling Machines.

Asquith, William, Ltd., Well Road Works, Halifax.  
Greenwood & Batley, Albion Works, Leeds.  
Niles-Bement-Pond Co., 23-25, Victoria Street, London, S.W.  
Northern Engineering Co. (1900), Ltd., King Cross, near Halifax.  
Swift, George, Claremont Ironworks, Halifax.

### Rails.

Wm. Firth, Ltd., Leeds.

### Railway Wagons.

Nye, A. W., 110, Cannon Street, London, E.C.  
W. R. Renshaw & Co., Ltd., Phoenix Works, Stoke-on-Trent.

### Riveted Work.

F. A. Keep, Juxon & Co., Forward Works, Barn Street, Birmingham.

### Roofs.

D. Anderson & Son, Ltd., Lagan Felt Works, Belfast.  
Graham, Morton & Co., Ltd., Leeds.  
Head, Wrightson & Co., Ltd., Thornaby-on-Tees.

### Ropeways (Aerial).

Bullivant & Co., Ltd., 72, Mark Lane, London, E.C.

### Scientific Instruments.

Cambridge Scientific Instrument Co., Ltd. Cambridge.

### Spanners.

Williams, J. H. & Co., Brooklyn, New York, U.S.A.

### Stampings.

Thomas Smith & Sons of Saltley, Ltd., Birmingham.  
Williams, J. H., & Co., Brooklyn, New York, U.S.A.

### Stamps (Rubber).

Rubber Stamp Co., 1 & 2, Holborn Buildings, Broad Street Corner, Birmingham.

### Stamps (Metal).

Edward Pryor & Son, 68, West Street, Sheffield.

### Steam Traps.

British Steam Specialties, Ltd., Fleet Street, Leicester.  
Lancaster & Tonge, Ltd., Pendleton, Manchester.

### Steam Wagons.

Thornycroft & Co., Ltd., J. I., Chiswick, London, W.  
Yorkshire Patent Steam Wagon Co., Pepper Road, Hunslet, Leeds.

### Steel Tools.

Saml. Buckley, St. Paul's Square, Birmingham.  
Pratt & Whitney Co., 23-25, Victoria Street, London, S.W.

### Steel Structures.

Ashmore, Benson, Pease & Co., Ltd., Stockton-on-Tees.

### Stokers.

Ed. Bennis & Co., Ltd., Bolton, Lancs.  
Meldrum Brothers, Ltd., Atlantic Works, Manchester.

### Stone Breakers.

S. Pegg & Son, Alexander Street, Leicester.

### Superheaters.

A. Bolton & Co., 40, Deansgate, Manchester.

### Time Recorders.

Howard Bros., 10, St. George's Crescent, Liverpool, and 100, Queen Victoria Street, London, E.C.  
Recorders, Ltd., 171, Queen Victoria Street, London, E.C.

### Tubes.

Premier Boiler Tubes, Ltd., 28, Victoria Street, London, S.W.  
Thomas Piggott & Co., Ltd., Spring Hill, Birmingham.  
Tubes, Ltd., Birmingham.

### Turbines.

G. Gilkes & Co., Ltd., Kendal.  
Greenwood & Batley, Albion Works, Leeds.  
S. Howes, 64, Mark Lane, London, E.C.

### Typewriters.

Elliott-Fisher Co., 85, Gracechurch Street, London, E.C.  
Empire Typewriter Co., 77, Queen Victoria Street, London, E.C.  
Yost Typewriter Co., 50, Holborn Viaduct, London, E.C.

### Valves.

Holmes & Co., W. C., Huddersfield.  
Scotch and Irish Oxygen Co., Ltd., Rosehill Works, Glasgow.  
Shaw, Joseph, Albert Works, Huddersfield.  
Winn, Charles, & Co., St. Thomas Works, Birmingham.

### Ventilating Appliances.

Matthews & Yates, Ltd., Swinton, Manchester.

### Wagons—Steam.

Thornycroft & Co., J. I., Ltd., Chiswick, London, W.

### Weighing Apparatus.

W. & T. Avery, Ltd., Soho Foundry, Birmingham, England.  
Samuel Denison & Son, Hunslet Moor, near Leeds.  
Graham, Morton & Co., Ltd., Leeds.

### Wells Light.

A. C. Wells & Co., 100A, Midland Road, St. Pancras, London, N.W.

### Wind and Water Supply Machinery.

Eric S. A. Smith, Bridlington.

### Wire Working Machinery.

Ed. Brand, 35, Shakespeare Street, Manchester.

### "Woodite."

"Woodite" Company, Mitcham, Surrey.



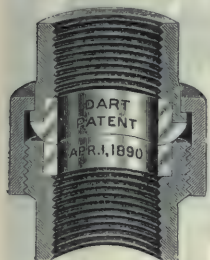
# PAGE'S WEEKLY

## Miscellaneous

DART

# Union Couplings.

These Couplings are made with Bronze Seat, and Ball and Socket Bearings, having joint ground perfectly true. They possess all the advantages of Gun Metal Unions combined with the strength of Malleable Iron.



They are used without any packing rings, and can be disconnected as often as desired, and again re-connected as easily as a common nut is tightened. The ball and socket joint secures absolutely tight connection, even when there are inaccuracies or variations in the alignment of the pipe. They are particularly adapted for use on locomotives, portable steam plants, or other machinery where convenience in disconnecting is an advantage.

Their durability, their great convenience, and their extreme adaptability for various purposes, make the use of couplings of this construction very economical and advantageous.

Glasgow Office:

9, BOTHWELL STREET.

**THE FAIRBANKS COMPANY,**  
78-80, City Road, London, E.C.

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Their Design, Organisation, and Management.

By CHAS. H. WORDINGHAM, A.K.C., M.I.C.E., M.I.M.E.

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Introductory.—Central Station Work as a Profession.—As an Investment.—The Establishment of a Central Station.—Systems of Supply.—Plant.—Boilers.—Systems of Draught and Waste Heat Economy.—The Transmission of Steam.—Generators.—Condensing Appliances.—Switching Gear, Instruments, and Connections.—Distributing Mains.—Insulation, Resistance, and Cost.—Distributing Networks.—Service Mains and Feeders.—Testing Mains.—Meters and Appliances.—Standardising and Testing Laboratory.—Secondary Batteries.—Street Lighting.—Cost.—General Organisation.—Mains Department.—Installation Department.—Standardising Department.—Drawing Office.—Clerical Department.—The Consumer.—Routine and Main Laying.—INDEX.

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### ELECTRICITY CONTROL.

A Treatise on Electric Switchgear and Systems of Electric Transmission.

By LEONARD ANDREWS, A.M.I.C.E., M.I.E.E.,

Ex-Member of Council of the Incorporated Municipal Electric Association; Consulting Electrical Engineer to the Hastings Corporation, etc., etc.

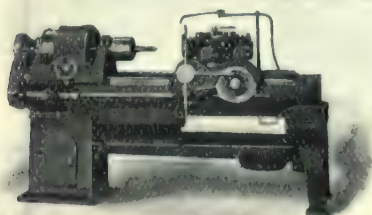
General Principles of Switchgear Design.—Constructional Details.—Circuit Breakers or Arc Interrupting Devices.—Automatically Operated Circuit Breakers.—Alternating Reverse Current Devices.—Arrangement of Bus Bars, and Apparatus for Parallel Running.—General Arrangement of Controlling Apparatus for High Tension Systems.—General Arrangement of Controlling Apparatus for Low Tension Systems.—Examples of Complete Installations.—Long Distance Transmission Schemes.

"Well written. . . Admirably illustrated. . . The diagrams in particular are remarkably good and clear."—*Scotsman*.

London: CHARLES GRIFFIN & CO., Ltd., EXETER STREET, STRAND, W.C.

## TURRET LATHES.

BRITISH MAKE THROUGHOUT.



See our page  
Advertisement  
next week.

THE ECLIPSE TOOL MANUFACTURING CO.,  
LINWOOD, near GLASGOW.



SECTION OF 'DRUM' PUMP.

## THE... "DRUM" PUMP.

JOHNSON'S PATENTS.

Write for Catalogue 63.

POSITIVE ACTION.  
NO VALVES.  
HIGH EFFICIENCY.

DRUM  
ENGINEERING CO.,  
27, Charles St.,  
BRADFORD.



# PAGE'S WEEKLY Hydraulic Machine Tools

THE

## Vauxhall & West Hydraulic Engineering Co. LTD.

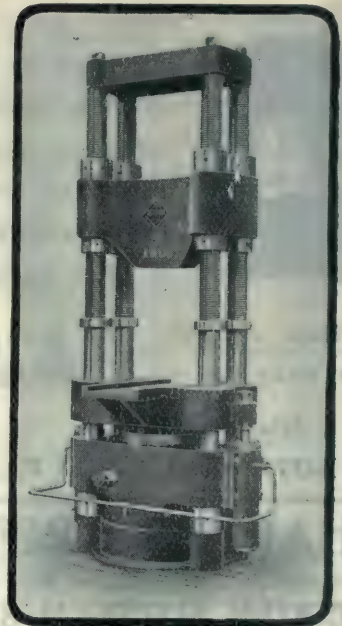
23, COLLEGE HILL, LONDON, E.C.

Contractors for Hydraulic  
Plant and Testing Machines  
to the Governments of

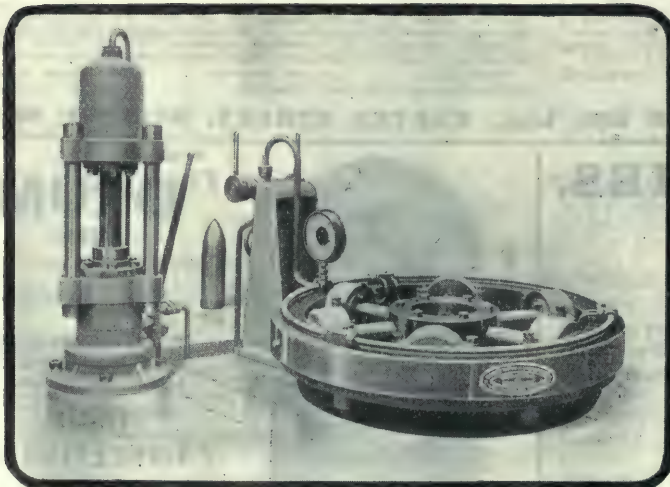
GREAT BRITAIN,  
INDIA,  
GERMANY,  
FRANCE,  
RUSSIA,  
ITALY,  
SPAIN,  
BELGIUM,  
SWITZERLAND,  
HOLLAND,  
JAPAN,  
CHILI,

Crown Agents for the  
Colonies,

&c., &c.



Shell Press.

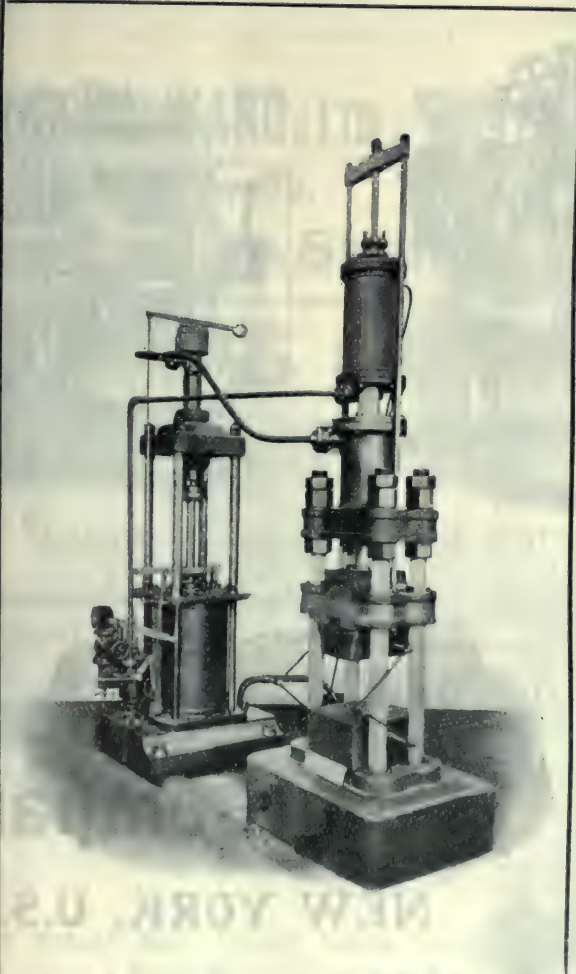


Patent Shell-Banding Press.



**PAGE'S WEEKLY** Machine Tools

The Kalk Machine Works  
**BREUER, SCHUMACHER**  
& CO., LTD.,



**KALK, near Cologne-on-  
Rhine  
(GERMANY).**

Department I.

**MACHINE TOOLS.**

Department II.

**AUXILIARY MACHINERY  
FOR STEEL WORKS, &c.**

Department III.

**ROLLING MILL PLANTS.**

Department IV.

**HYDRAULIC MACHINERY.**



# PAGE'S WEEKLY

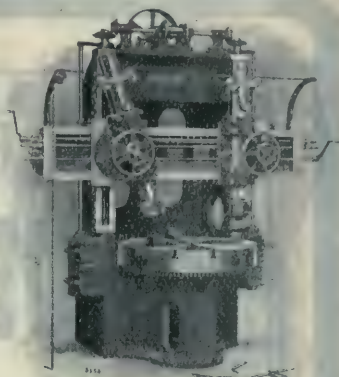
## Machine Tools

### MACHINE TOOLS.

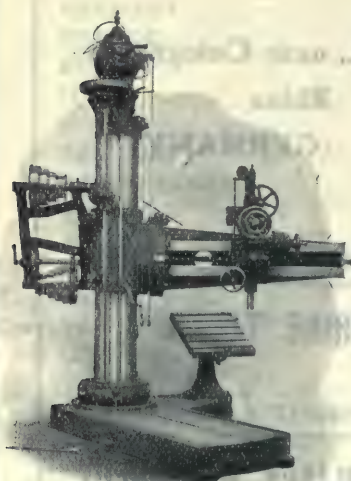
**ELECTRIC  
TRAVELLING  
CRANES and  
HOISTS.**



3 ton Electric Hoist.



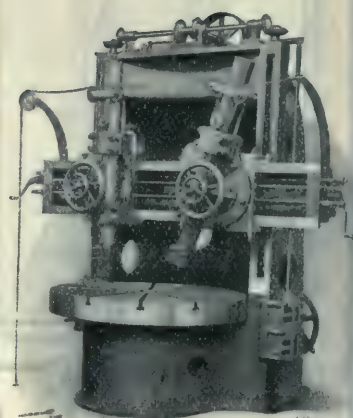
37 in. Boring Mill.



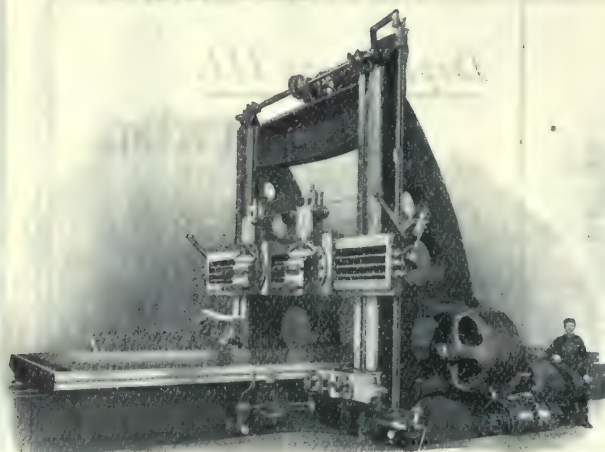
5½ ft. Universal Radial Drill



50 in. Vertical Drill.



51 in. Boring Mill.



10 ft. Planer, Pneumatic Clutches.

**Complete Equipment for Locomotive,  
Machine, and Repair Shop.**

## Niles-Bement- Pond Company

**NEW YORK, U.S.A.**

**23-25, Victoria Street, London, S.W.**

TELEGRAMS:—

NILESCO, NEW YORK."

"NILIACUS, LONDON."



# PAGE'S WEEKLY Machine Tools

## Radial Drilling Machines.

NEW AND IMPROVED DESIGNS.  
DISPENSING WITH OVERHANG-  
ING TOP SHAFT

## High-Class Machine Tools.

IN STOCK FOR . . . .  
IMMEDIATE DELIVERY.

*Send for Descriptive Catalogue.*

**THOS. W. WARD, LTD.,**

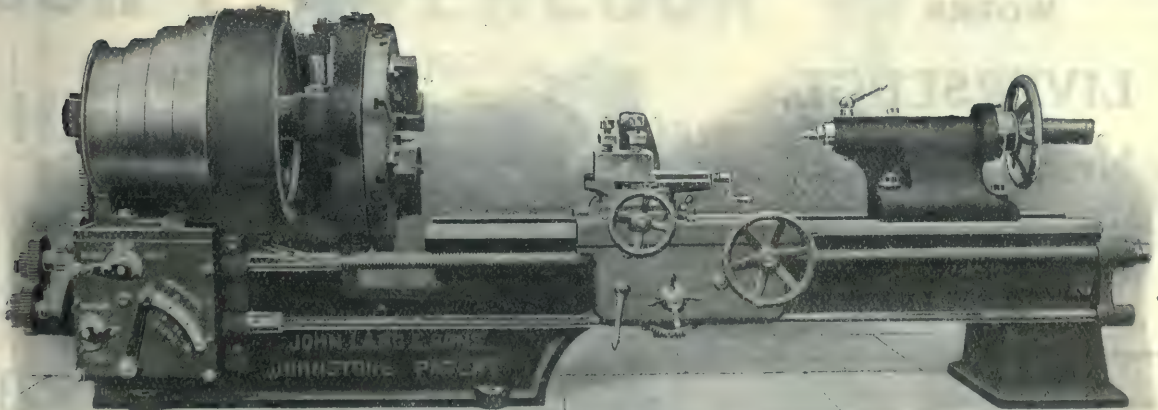
**Albion Works,**

Telegrams:—  
 "FORWARD, SHEFFIELD."

**Sheffield.**



## LANG'S HIGH-SPEED LATHES



Have Patent Bed, Patent Loose Head, Patent Screw-Cutting and Feed Motions, also  
 Enormous Power combined with Convenience of Manipulation.

**JOHN LANG & SONS,** Johnstone, near Glasgow.



PAGE'S WEEKLY

Machine Tools

**3** Styles of Drive

Belting  
Belting and Gearing  
Gearing

# 3'6" to 6'0" RADIALS

HIGHEST

RATE OF

FEEDS . .

**Largest English Makers.**

**Northern Engineering**

(1900) Co., Ltd.,

**HALIFAX.**

**YORKSHIRE MACHINE TOOL & ENGINEERING**

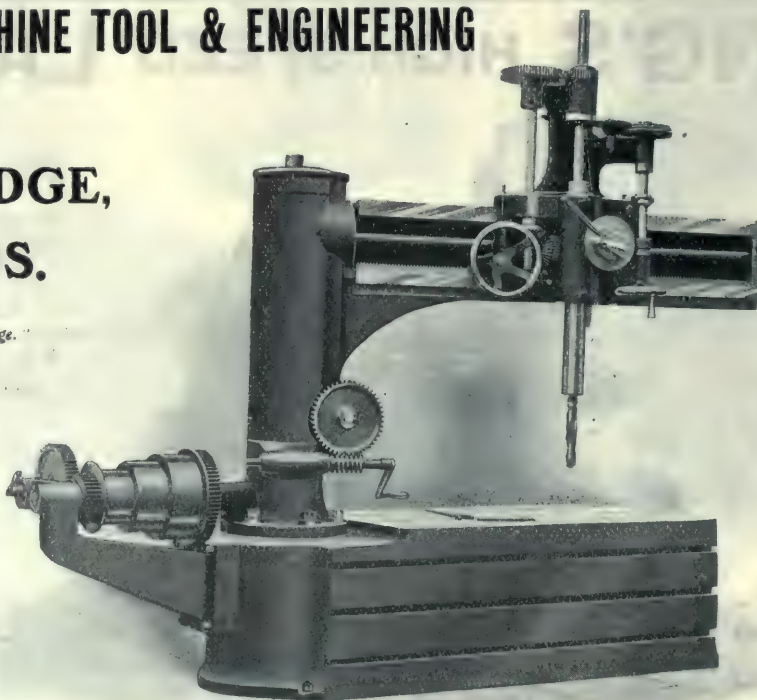
WORKS,

**LIVERSEDGE,**

**Nr. LEEDS.**

Telegraphic Address: "Alma, Liversedge."  
Nat. Tel.: 38 Heckmondwike.

Designers and Builders  
of  
High-Class Machine  
Tools.

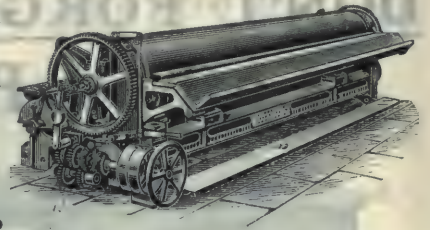
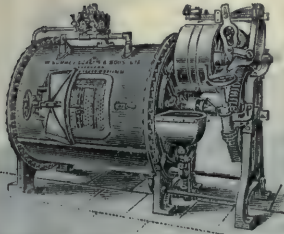


6 ft. arm High Speed Radial Drill. Capacity, six  $\frac{1}{2}$  holes through 1 in. plates per minute. 600 revolutions on drill. No belt feed.



# PAGE'S WEEKLY Machine Tools, &c.

## Laundry Machinery AND COOKING APPARATUS.



**W. Summerscales & Sons, Ltd.**

CATALOGUE  
ON APPLICATION.

*Phoenix Foundry, KEIGHLEY, ENGLAND.*

**Dean, Smith, & Grace,**

Lathe Manufacturers,

Established  
1865.

**KEIGHLEY.**

**WRITE FOR CATALOGUE.**

See Our Advertisement next Week.

## HIGH-CLASS LATHES AND RADIAL DRILLS

*Write for our Lists.*



**D. MITCHELL & CO.**

Parsonage Works, KEIGHLEY.

Telegrams: "TOOLS, KEIGHLEY."

*On War Office and India Office Lists.*

## DON'T OVERLOOK

the IMPORTANCE of

## High-Speed Drilling

when modernising your plant.

OUR NEW RADIALS are the  
MOST ADVANCED and  
BEST SUITED to the  
changed conditions.

**CENTRAL SPINDLE THRUST,**  
**GREAT BELT POWER** at all speeds,  
**HIGH EFFICIENCY** at heavy duty.

*Illustration shows 5 ft. machine.*



Radials, from 3 ft. 6 in. radius, upwards.

Verticals—Pillar and Box Body.

Girder Radials for high speeds.

Horizontal Drills, 2-in. spindle and upwards.

Horizontal Boring Machines, 2½-in. spindle and upwards.

**WM. ASQUITH, LTD.,**

Well Road Works,

**HALIFAX, England.**

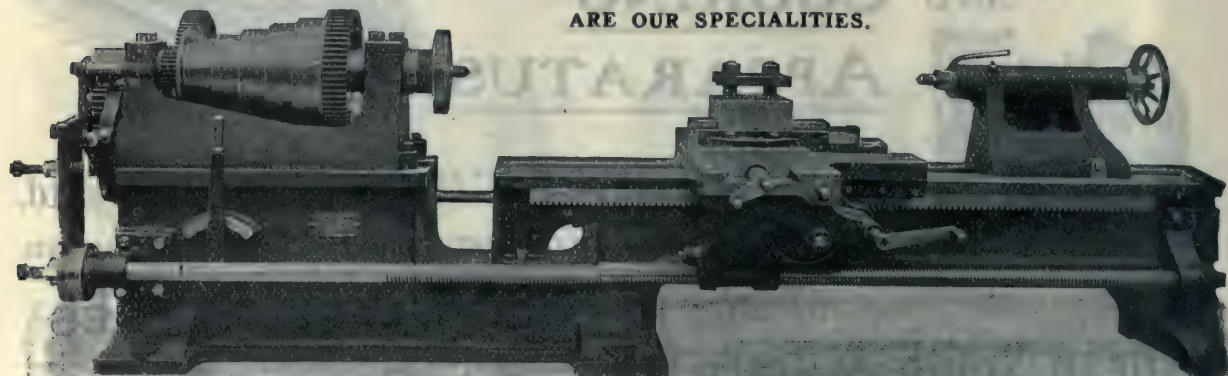


# PAGE'S WEEKLY Machine Tools

**DON'T FORGET**

## Lathes, Planers, and Shapers

ARE OUR SPECIALITIES.

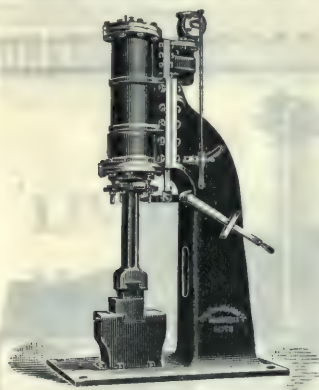


High-Grade Machines Only  
in Stock for  
Immediate Delivery.

### C. Redman & Sons,

National Telephone: 308.  
Telegrams: "REDMANS, ENGINEERS, HALIFAX."

HALIFAX.



## STEAM HAMMERS

FOR SMITHS' SHOPS AND FORGES.

*Patent Bevelling Machines for Ships' Frame.*

### DAVIS & PRIMROSE,

Leith Ironworks, EDINBURGH.



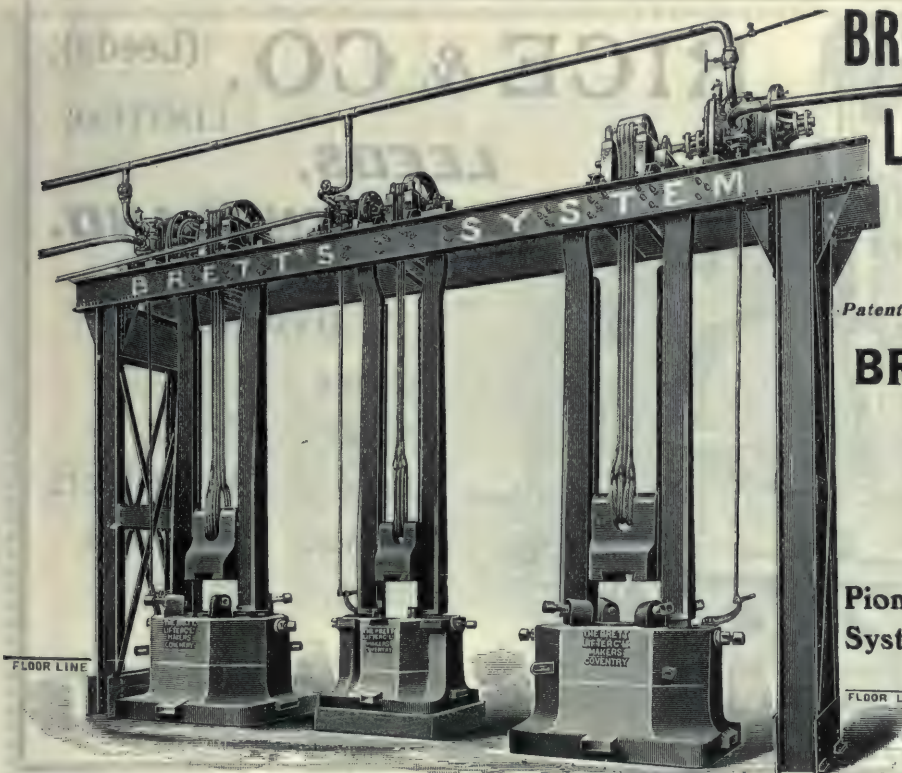
## Gve. DETOMBAY, Mce. DELANGE & Cie.

Engineering Works, HOBOKEN, near ANTWERP.

SPECIALITIES: APPLIANCES FOR PUBLIC WORKS:—  
Dredgers. — Elevators. — Excavators. — Tugs. — Centrifugal  
Pumps.—Sand Pumps.—Ballast Barges.—Lighters.—Yachts.—  
Hand, Steam and Hydraulic Cranes.—Drawbridges.—Pontoons.  
—Derricks.—Hand and Steam Winches.—Steam Engines.—  
Traction Engines.—Plant for Blast Furnaces.—Steel Works,  
Rolling Mills.—Gasholders.—Steam Hammers.—Shearing and  
Plate-edge Planing Machinery, &c.



# PAGE'S WEEKLY Machine Tools



**BRETT'S PATENT  
LIFTER CO. Ltd.,**

Coventry, England.

Patentees and Manufacturers of

**BRETT'S  
PATENT  
LIFTERS,  
ETC.**

Pioneers of the Modern  
System of Drop Forging.

Telegraphic Address :  
"LIFTER, COVENTRY."  
Telephone No. : 384.

## BATEMAN'S MACHINE TOOL Co., LTD.,

Makers of . . .

### HIGH-SPEED PLANERS ONLY

Address : Hunslet, LEEDS.

#### OUR PATENT MACHINES

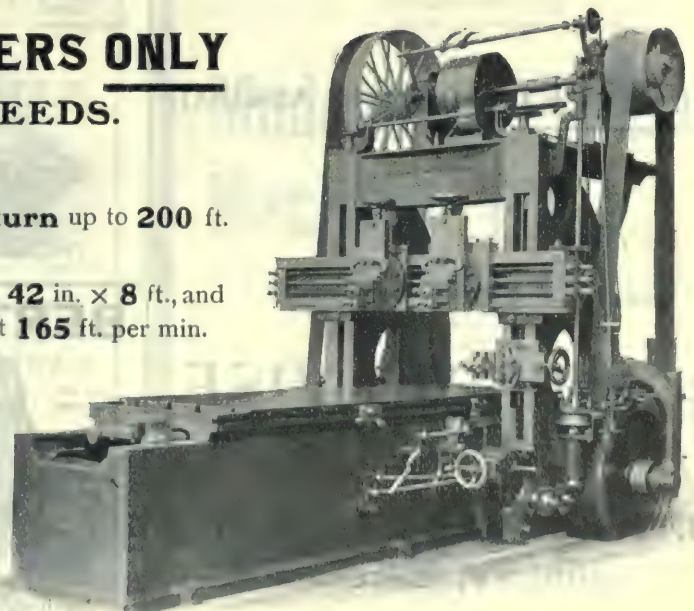
Cut up to **80** ft. per min. and **Return** up to **200** ft. per min. according to size.

The Machine illustrated is a **42 in. × 42 in. × 8 ft.**, and **Cuts** at **60** ft. per min., **Returns** at **165** ft. per min.

With Two Tools at  $\frac{1}{8}$  in. feed, it will plane **4,032** sq. in. in **30 to 35** mins.

With a cut  $\frac{3}{8}$  in. deep, at  $\frac{1}{8}$  in. feed, it will remove nearly  **$\frac{1}{2}$ -TON** of metal per hour.

Our **60 in. × 60 in. × 12 ft.** Planer **Cuts** at **60** ft. per min., **Returns** at **130** ft. per min.



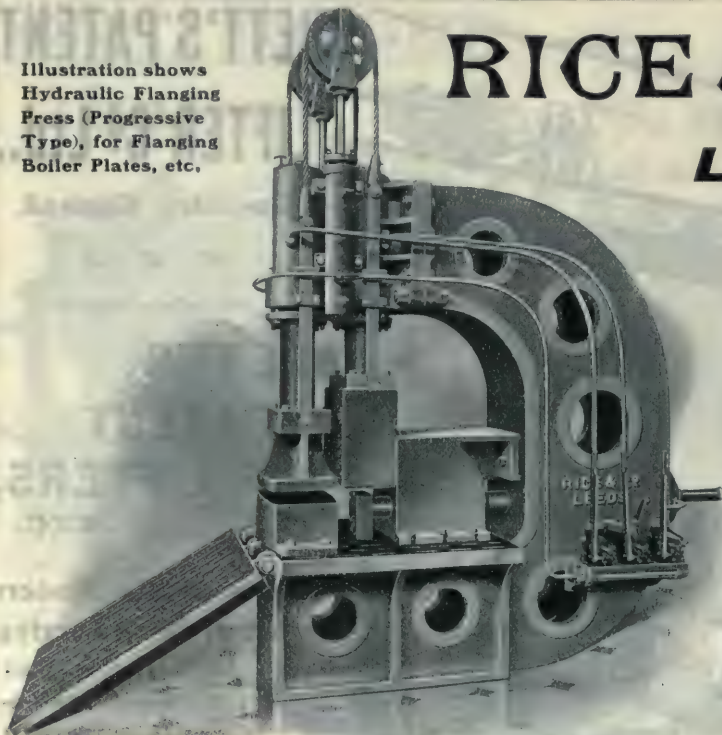
42 in. × 42 in. × 8 ft. PATENT HIGH-SPEED PLANER.



# PAGE'S WEEKLY

## Machine Tools

Illustration shows  
Hydraulic Flanging  
Press (Progressive  
Type), for Flanging  
Boiler Plates, etc.



## RICE & CO., (Leeds), LIMITED, LEEDS, ENGLAND.

### HYDRAULIC

Riveters,	Lifts,
Presses,	Pumps,
Cranes,	Accumulators,
Punches,	Intensifiers,
Shears,	Valves,
Hoists,	&c., &c.

A B C Code, 4th Edition, used.  
Telegraphic Address: "Press, Leeds."  
Telephone No.: 2362.

## "ABOUT VISES."

A BOOKLET (FOR THE ASKING)

*By the  
Makers of the*

## "PERFECT" VISE.

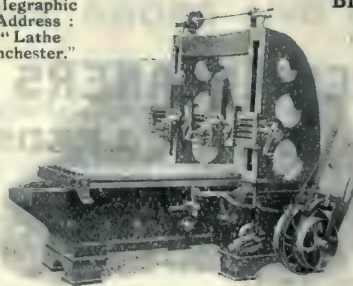
**J. PARKINSON & SON,  
SHIPLEY, ENGLAND.**

Cables: "TEMPLES, SHIPLEY."  
Code: A B C 5th Edition.

## CUNLIFFE & CROOM, L<sup>TD.</sup>,

Broughton Lane,  
**MANCHESTER.**

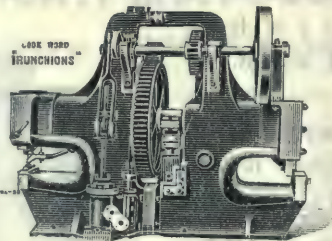
Telegraphic  
Address :  
"Lathe  
Manchester."



**PATENT  
PLANING  
MACHINES.**

Ask for Descriptive  
Sheet.

## BERTRAMS LIMITED



St. Katherine's Works,  
Sciennes,  
**EDINBURGH.**

London Office:  
**MOORGATE  
STATION  
CHAMBERS, E.C.**

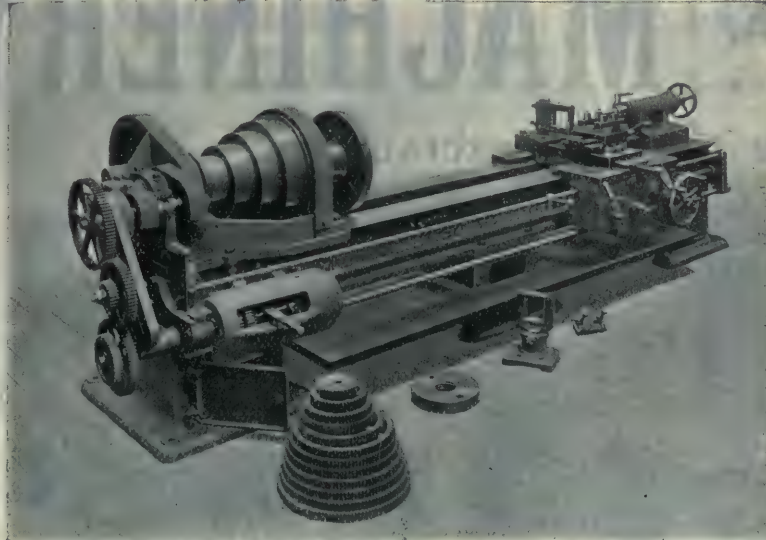
Punching, Shearing, and Angle Iron  
Cutting Machine.

**MACHINE TOOLS**

For Engineers, Shipbuilders,  
Boiler Makers, etc., etc.



# PAGE'S WEEKLY Machine Tools



**WE MAKE  
HIGH-SPEED  
LATHES**

**A Speciality.**

"ACCURATE."

"DURABLE."

"POWERFUL."

8½ in., 10 in., and 12 in.  
Centres.

REASONABLE IN PRICE.

UNEQUALLED IN POWER.

Send us your  
Inquiries.

**NOBLE & LUND, LIMITED,  
FELLING-ON-TYNE.**

**Luke & Spencer, Ltd.,  
BROADHEATH,  
MANCHESTER.**

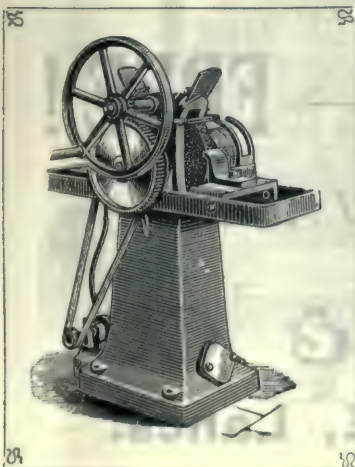
Telegraphic Address:  
"Emery, Altrincham."

National Telephone:  
"Altrincham 49."

**Manufacturers of**

**GRINDING.  
and . . . . .  
POLISHING  
MACHINES.  
EMERY. . . .  
WHEELS. . .  
Etc. . . . .**

Send for our  
Enlarged  
Catalogue,  
free on  
Application.



TELEPHONE NO.: 1469.

TELEGRAMS: "TUDOR, BIRMINGHAM."

## Modern Machine Tools.

CAPSTAN AND TURRET LATHES.  
DRILLING MACHINES.  
MILLING MACHINES.  
BORING MACHINES.

**H. W. WARD & Co.**

ONLY ADDRESS—

**86, Lionel Street,  
BIRMINGHAM.**

Contractors to British and Foreign Governments  
and Principal Engineering Firms.

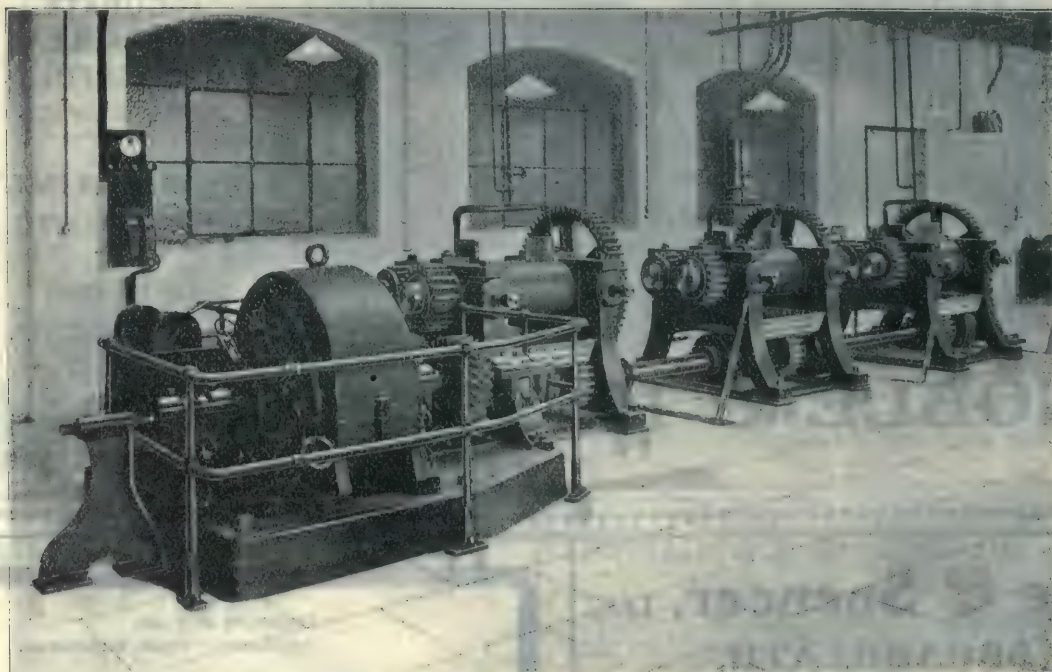


# PAGE'S WEEKLY Friction Clutches

INDIA-RUBBER,  
GUTTA PERCHA,  
AND BALATA - -

# MACHINERY

ONE OF OUR SPECIALITIES.



This Illustration represents Three of our Washing Mills (motor driven), each driven with our Heywood and Bridge's Patent Friction Clutches, and provided with our Patent Semi-Automatic Disengaging Gear.

## Send for 100 Page Work—FREE!

*MAKERS OF COMPLETE PLANTS.*

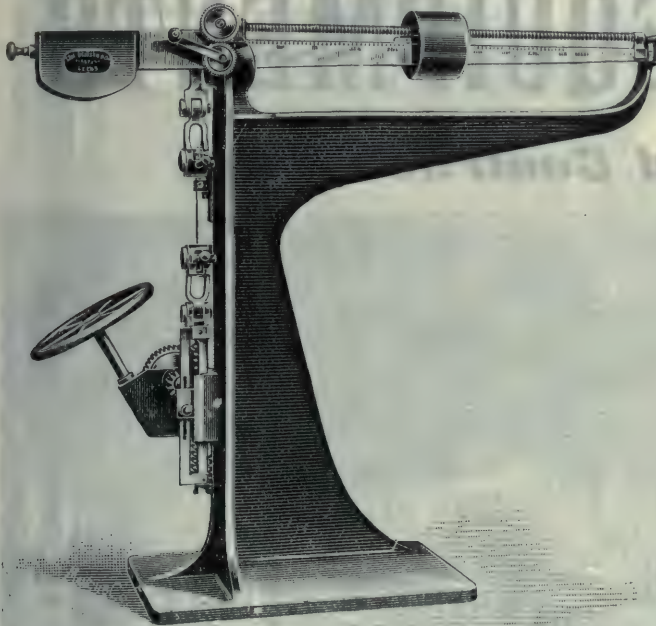
## DAVID BRIDGE & CO.,

Castleton Iron Works, **ROCHDALE, Lancs.**



# PAGE'S WEEKLY Testers, Weighers, &c.

## Denison's SINGLE LEVER Wire Tester.



This apparatus is arranged for ascertaining the tensile strength of small wire, and is very accurate.

NO LOOSE WEIGHTS.  
ACCURATE EXTENSION GAUGE.

Capacity	...	1,000	lbs. avoird.	(1)
"	...	1,250	" "	(2)
"	...	1,500	" "	(3)

The 'poise weight carries a vernier to show single pounds.

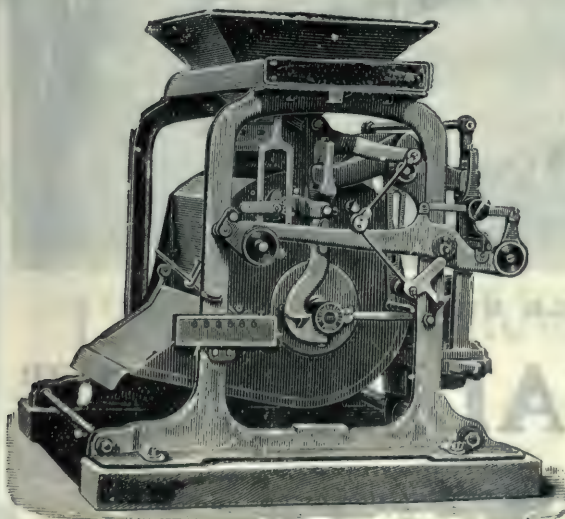
RAPID IN USE.  
PATTERN B.

### SAML. DENISON & SON, LTD.,

*Hunslet Moor,*

Telegrams: "WEIGH, LEEDS." Near **LEEDS.**

## WEIGHING MACHINES & GRAIN SCALES.



**HOWES' WEIGHING MACHINES**  
for all purposes.

**AUTOMATIC GRAIN SCALES**

for use in

**ELEVATORS, FLOUR MILLS, &c.**

**WEIGHINGS ACCURATE.**

Sole Manufacturers of the "LITTLE GIANT" Turbines, Water Motors, and Pelton Wheels, &c.

## S. HOWES CO.

Head Office:— 64, MARK LANE, LONDON, E.C., ENGLAND.



# PAGE'S WEEKLY Mining Machinery

## COMPLETE MINING EQUIPMENTS

*Designed and Contracted for.*



200 STAMP GOLD MILL.

# FRASER & CHALMERS, L<sup>TD</sup>

*Mining and Engineering Machinery,*

HEAD OFFICE: 3, LONDON WALL BUILDINGS, LONDON, E.C.

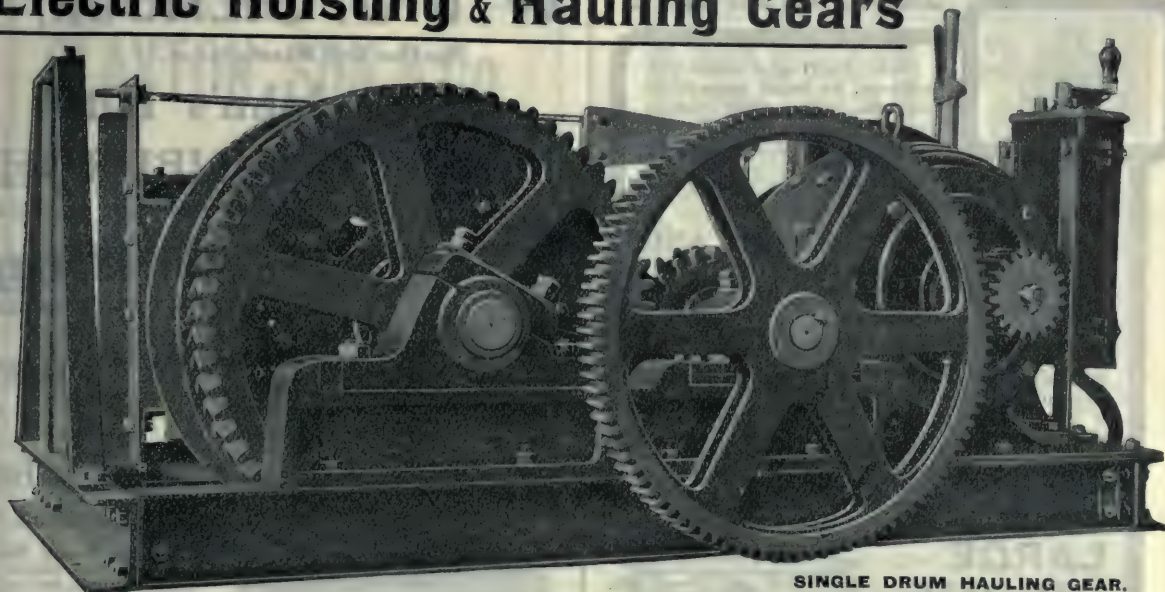
Works: ERITH, KENT, ENGLAND.



# PAGE'S WEEKLY

Gears, &amp;c.

## Electric Hoisting & Hauling Gears



SINGLE DRUM HAULING GEAR.

OUR SPECIALITIES ARE:—

Telephone: No. 4608.

Telegrams: "Hauling, Birmingham."

Haulage and Hoisting for all purposes; also Pumping.

**M. B. WILD & CO.,**HEAD OFFICE:—  
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Corporation Street,  
Works: NECHELLS, BIRMINGHAM.**BIRMINGHAM.**

## J. B. HAMILTON & CO.,

Late of 145, Cannon Street, LONDON, E.C.,

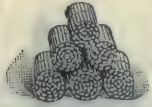
Respectfully announce that they have Removed  
to more commodious premises at**12, Euston Buildings, LONDON, N.W.,**Where they hope to be favoured  
with your inquiries for**"UNICA" SILENT GEARS.**



# PAGE'S WEEKLY

## Miscellaneous

### MONEY IN IT



Those desiring a lucrative business, or being already in business, have slack times, Power, Premises, &c., at disposal, would find our

New Patent

**FIREWOOD, SAWING,  
SPLITTING, ARRANGING, AND  
BUNDLING MACHINES,**

**Compressed Saw-dust**

**Firelighter Machine,**

A very profitable investment for turning Old, New, or Waste Wood, Sawdust, &c., into a saleable commodity, there being an almost unlimited demand for these lines.

These machines do the work of from 12 to 80 men; the saving in wages alone means

**A . . . .  
CERTAIN  
LARGE  
INCOME.**

Inquiries solicited for all classes of special wood working machinery. Guards of every description for same a Speciality.



## W. & O. GILMOUR,

Machine Belt Manufacturers,

**St. John's Hill,  
EDINBURGH.**

Telegrams: "BELTING, EDINBURGH."

Telephone No.: 575 Centraj.

### Belting

MADE FROM

**PURE OAK TANNED  
LEATHER.**

**Quality is Our First  
Consideration.**

For over Eighty Years we have been makers of Leather Belting, but owing to the present demands of trade we have just laid down extensive plant, and are now in a position to supply Oak Tanned Leather Belting at as reasonable a price as is consistent with first-class goods.



**GEOLOGISTS tell us that our  
World is Flattened at the Poles.**

We do business in every other part where steam power is used, and we've hopes about the flattened portions, too.

Write us re

## DANIEL'S

### P.P.P.

TO

**Quaker City Rubber Co.,**

Coronation House,  
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**LONDON, E.C.**

(Late 101, Leadenhall St., E.C.)

RONALD TRIST & Co.,  
MANAGERS FOR GREAT BRITAIN.

**You'll be glad about it afterwards.**





**PAGE'S WEEKLY**

**Steelwork, &c.**

**CLAYTON, SON & Co.,**

LTD.

**HUNSLET, LEEDS,**

MAKERS OF THE

**LARGEST STEEL TANK**

AND THE

**LARGEST GASHOLDER**

**IN THE WORLD.**

**ROOFING,**

**CONSTRUCTURAL**

**STEEL WORK,**

**PETROLEUM TANKS.**

Wires:—

London Office:—

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**Blast Furnace**

CASINGS AND SHELLS  
RIVETTED STEEL MAINS

Kilns  
GANTRY'S  
Coke Ovens & Cars  
FURNACES AND STOVES  
Chimneys & Tanks  
DROPS  
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UP TO ANY DIAMETER

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Necks  
GRIDS  
Bells & Hoppers  
GAS AND AIR VALVES  
Stanchions  
COLUMNS  
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UP TO ANY DIAMETER

**STEEL STRUCTURES**

send for Estimates.

**ASHMORE, BENSON, PEASE & CO. LTD.** STOCKTON ON TEES.  
TELEGRAMS: GASHOLDER

THE

**Phosphor  
Bronze  
Co., Ltd.**

Incorporated 1874.

**SOUTHWARK,  
LONDON, S.E.**

And at BIRMINGHAM.

**"White Ant" Metal**

Is the Cheapest and Most Reliable of  
White Anti-Friction Alloys.

**PLASTIC METAL.**

("Cog Wheel" Brand.)

**"PHOSPHOR" WHITE  
LINING METAL.**

(Equal to White Brass No. 2.)

**"WHITE ANT"  
BRONZE.**

(Superior to Fenton's Metal.)

**BABBITTS METAL.**

("Vulcan Brand.") Seven Grades.

PHOSPHOR BRONZE,  
SILICIUM BRONZE,  
"WHITE ANT" METAL,  
PLASTIC METAL,  
BABBITTS METAL,  
Etc.

See Next Month's Advert.  
for Phosphor Bronze  
Alloys.



# PAGE'S WEEKLY

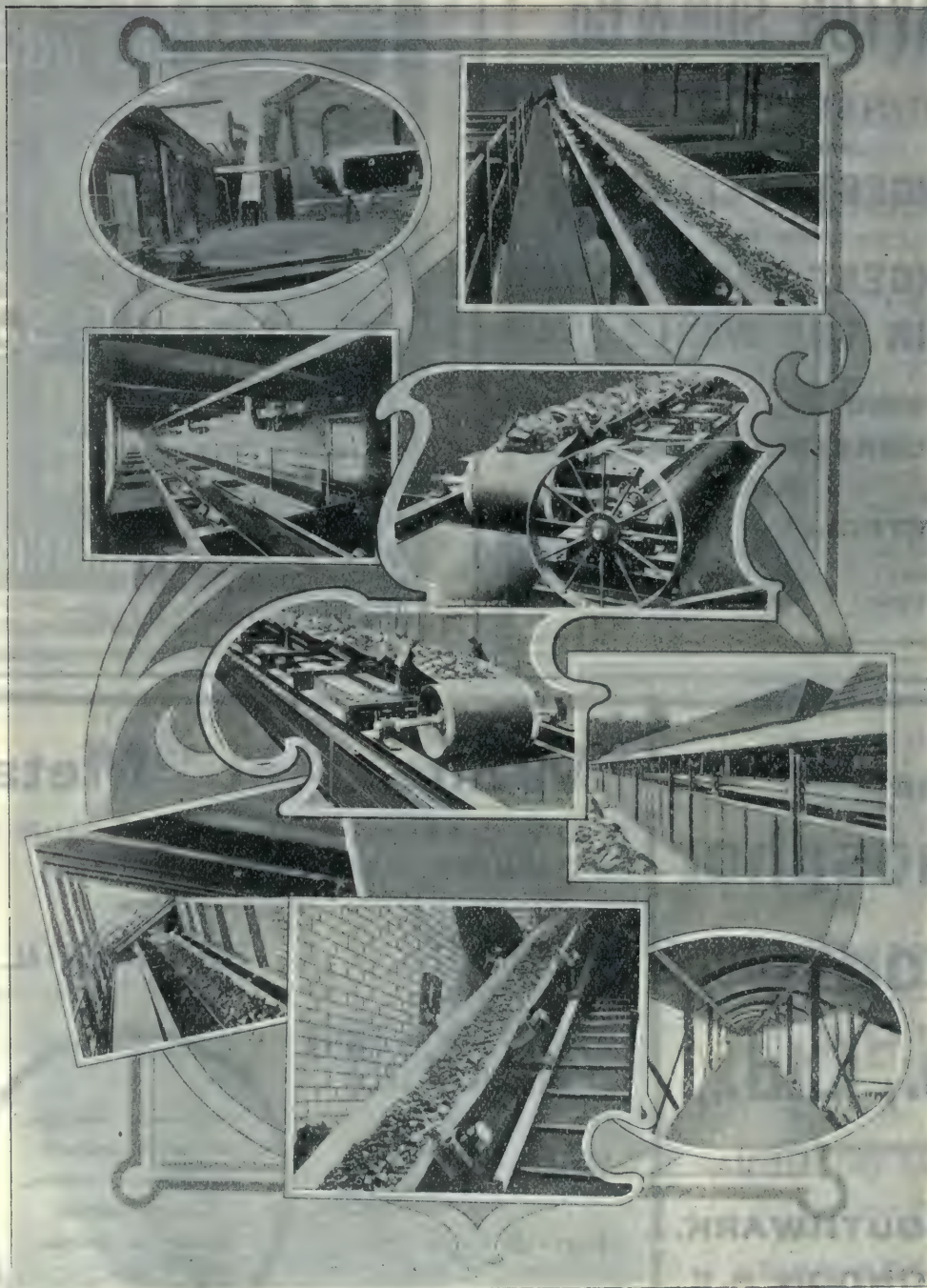
## Conveying Plant

# GRAHAM, MORTON

MAURICE GRAHAM.

Works and Head Offices : LEEDS.

&amp; CO., Ltd.



THE WHOLE OF THESE RUBBER BELT CONVEYING PLANTS WERE MADE AND ERECTED BY US COMPLETE.

Makers and Erectors of  
 CONVEYING PLANTS, COAL HANDLING PLANTS,  
 SCREENING PLANTS, WASHING PLANTS  
 AERIAL ROPEWAYS, STEEL STRUCTURAL BUILDINGS, ETC.

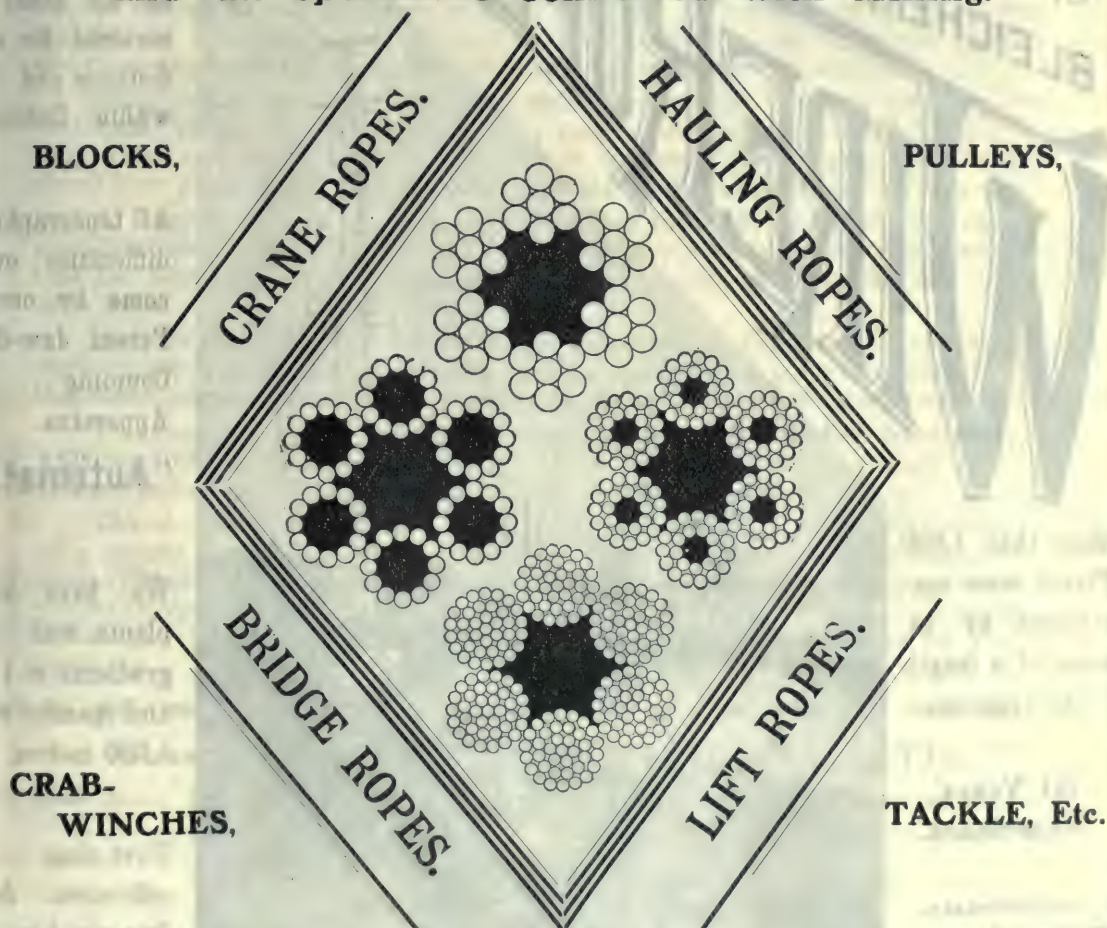




# BULLIVANTS'

## Steel Wire Mining Ropes.

Wire Ropes for Hauling and Winding Gear,  
and all operations connected with Mining.



*Stronger, Lighter, and Cheaper than Hemp Rope or Chain, and  
ABSOLUTELY RELIABLE.*

A Piece of every Mining Rope tested to Destruction, and a Test Certificate Supplied.

**BULLIVANT & CO., Ltd.,** Registered Offices: 72, Mark Lane, London.

Telephone No.: 2110 AVENUE.

Works: MILLWALL, E.



# PAGE'S WEEKLY

## Ropeways

**ADOLF BLEICHERT & CO., LEIPZIG-GOHLIS, GERMANY**

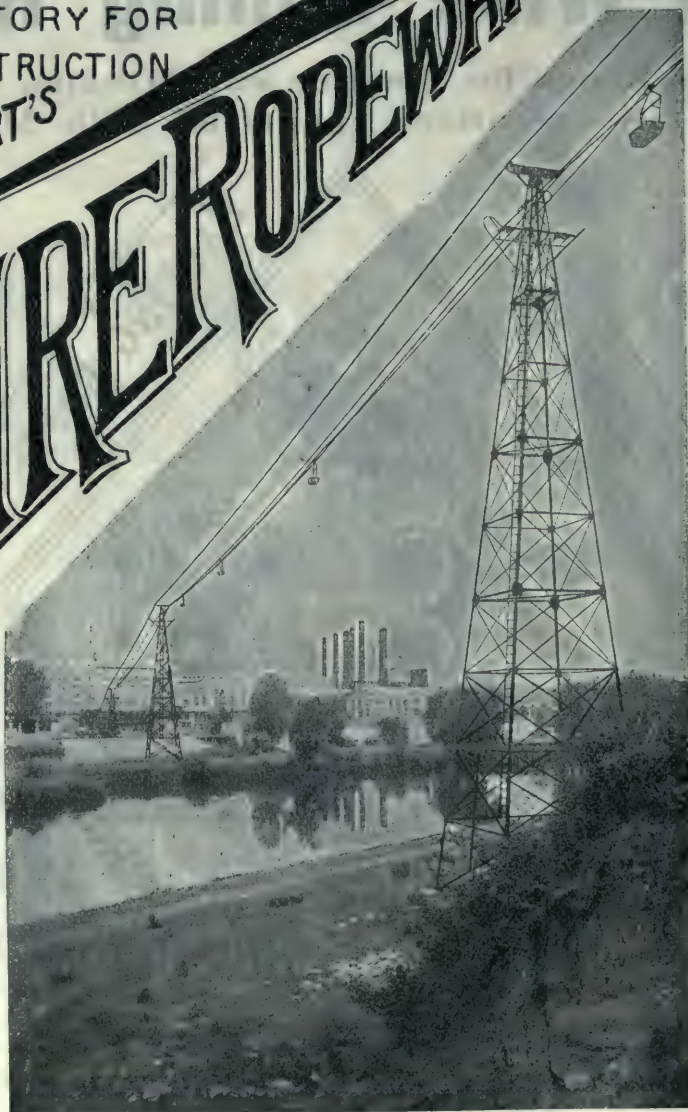
OLDEST AND LARGEST  
FACTORY FOR  
THE CONSTRUCTION  
OF

**BLEICHERT'S  
WIROPEWAYS**

More than 1,600  
Plants were con-  
structed by us,  
some of a length  
of 34 kilometres.

**30 Years'  
Experience.**

**Gold Medals.  
Highest Awards.**



Best and . . .  
cheapest medium  
of transportation  
for all kinds of  
material for any  
distance and . . .  
within factories.

All topographical  
difficulties over-  
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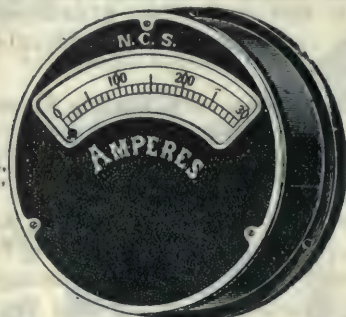
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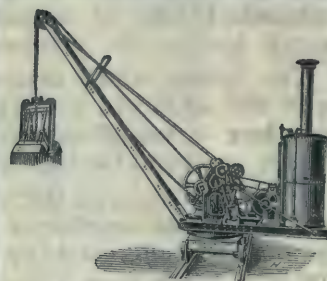
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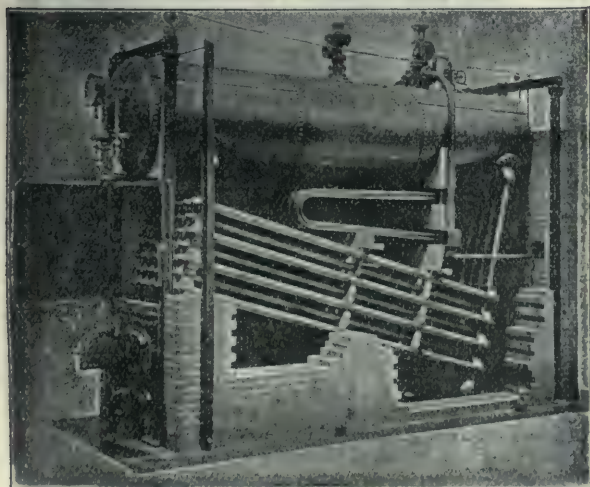
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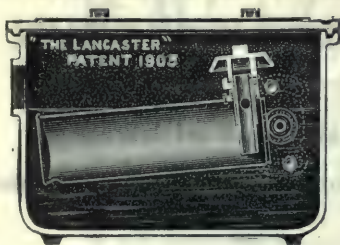


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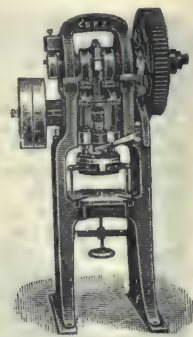
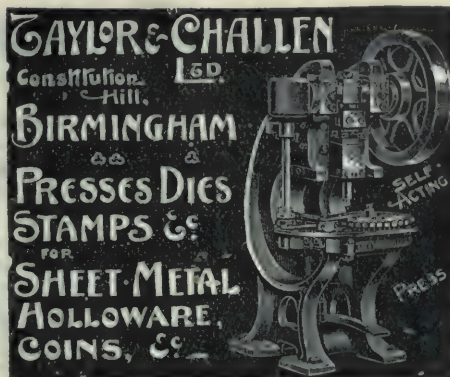
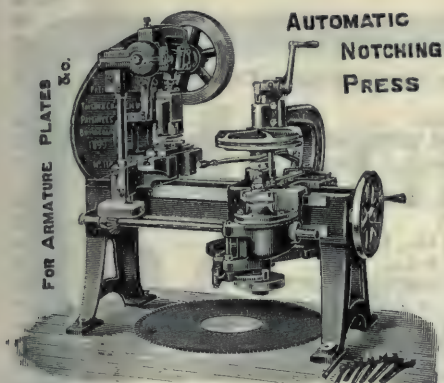
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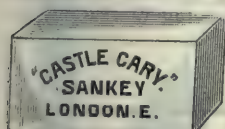
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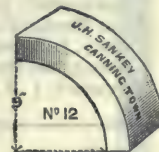
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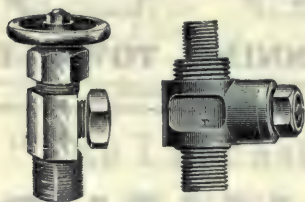
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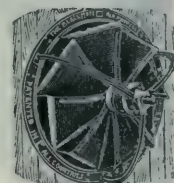


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# PAGE'S WEEKLY

## Miscellaneous

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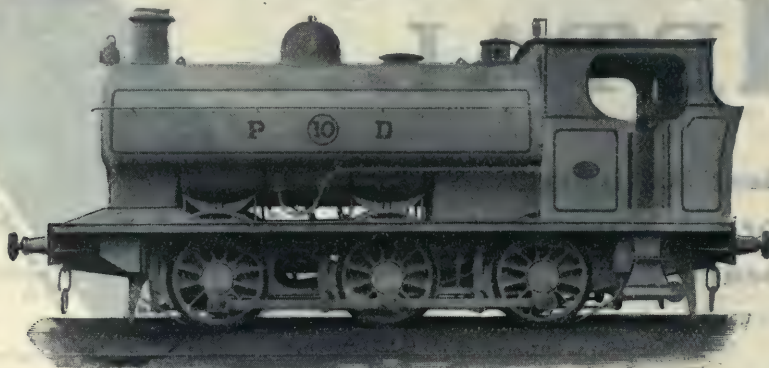
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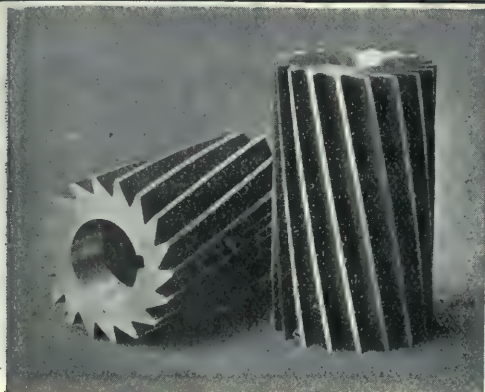
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# PAGE'S WEEKLY

An Illustrated Technical Weekly, dealing with the Engineering, Electrical, Mining, Iron and Steel, and Shipbuilding Industries.

VOL. VI.

LONDON, FRIDAY, MAY 12, 1905.

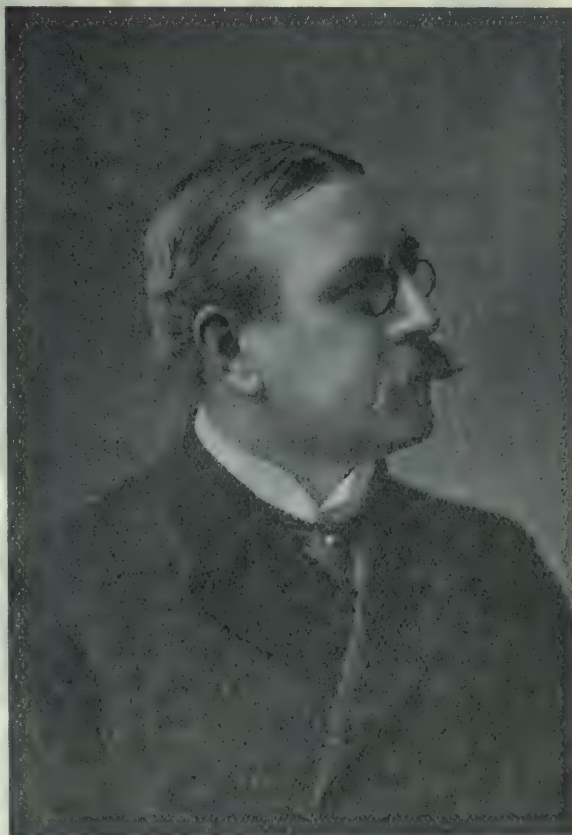
No 35.

## The Offices of "Page's Weekly," Wednesday Evening.



R. R. A. HADFIELD on Thursday inaugurated his presidency of the Iron and Steel Institute by delivering an address which was thoroughly characteristic. He has learnt in the school of the investigator that in the manufacture of iron and steel no detail is too insignificant to be examined and weighed, and accordingly we find that although more particularly confined to those branches of metallurgy dictated by environment and choice, the address was almost encyclopædic in the extent and variety of its information. The résumé which appears elsewhere, represents a composition which will occupy eighty-two pages of the official proceedings. The historical portion, which considerations of space have compelled us to pass over, was rendered free from the "dry bones" element by a collection of portraits of early iron and steel pioneers, unearthed by Mr. Hadfield and his friends with considerable trouble. The march of progress, however, has been so rapid that we have hardly time to congratulate the President upon his excellent notion, ere the whole historical collection must be consigned to the reference library, pending the realisation of that other brilliant idea, a portrait gallery of scientific men.

We are by no means astonished to find that Mr. Hadfield is a card system man, but we must confess that his really royal tribute to the technical press somewhat took us by surprise.



MR. ADOLPHE GREINER,

Who will act as President of the Metallurgical Section at the Liège International Congress of Mining, Metallurgy, Mechanics, and Applied Geology. He is a member of the Council of the Iron and Steel Institute.





VIEW OF ENGINE ROOM, HACKNEY ELECTRICITY AND DESTROYER STATION, SHOWING MACHINERY DRIVEN BY DESTROYER STEAM. (See page 1016.)

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Neither the technical nor any other press can consistently "blow its own trumpet" without loss of prestige and the more responsible technical papers are content to strive for a maximum of usefulness without going out of their way to seek praise. When, however, an engineer and scholar of Mr. Hadfield's attainments takes the earliest opportunity, *ex cathedra*, of paying an unqualified tribute to the technical press as a whole, we place it on record gladly, and as a matter of duty. Here it is:—

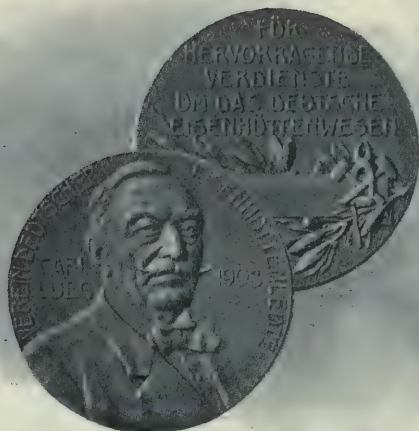
"I take this opportunity of expressing our great indebtedness to the technical press for the wonderful work they do in keeping us supplied with the most recent information. There are, I believe, now published about 103 important technical journals, many of them issued weekly. Even that hitherto dark spot, the foundry, has its monthly technical paper, and there is also a journal now devoted to the pattern-maker. At least half the technical papers deal with metallurgy and allied subjects, such as the industrial application of metallurgical products. Two-thirds of these papers are published in English, being equally divided between this country and America. Germany follows with about one-sixth of the total. It is not, of course, multiplicity of publications that is of chief value in technical literature; a higher consideration is the quality of the information; and next to that comes the number of readers.

"On this point, England and America can safely be said to hold their own. We often wonder at the marvels of daily journalism, but to me they do not seem to compare with the work done by the technical press, where the matter must be correct and exact. The daily press, however essential to our well-being, does work of a more or less ephemeral nature; that of technical papers is of a lasting description." After some helpful remarks on the

subject of abstracts, Mr. Hadfield says, finally: "I frankly confess that to the technical press I largely owe such progress as I have been able to make in acquiring information." Probably, Mr. Hadfield would have found the technical press less valuable had he been minus that strong individuality and infinite capacity for taking pains which have been associated with his success in searching out some of the mysteries of steel, but his tribute is none the less a notable one and will be treasured by the technical press as a whole.

One of the most valuable papers dealt with, the low temperature experiments carried out by Mr. Hadfield in conjunction with Sir James Dewar. As many iron alloys have shown anomalous results in their physical behaviour at ordinary temperatures, it became advisable to ascertain the exact effect of very low temperatures upon such bodies, and, accordingly, a series of tests were carried out on standard iron and steel alloyed with other elements, the specimens being selected from a large collection made by Mr. Hadfield, at the Hecla Works, Sheffield. In the course of the inquiry some 500 specimens were examined. The bars experimented upon were finished a length of two inches and a diameter of 0.180 in. between punch marks with an extra 0.060 in. at each end. The bars were then tested whilst immersed in liquid air, 182 deg. C. The results show that with the exception of the nickel-manganese-iron alloys, the effect of liquid air temperature is to increase in a remarkable degree the maximum tenacity of iron alloys, whilst in most cases their ductility disappears. These changes take place in the softest wrought iron as well as in the various carbon and other steels. In the case of the nickel-manganese-iron alloys, not only, however, is the ductility increased, but the tenacity reaches the high figure of 85 tons, with an elongation of no less than 67½ per cent. Further, there is no doubt that the useful toughening





THE CARL LUEG MEDAL.

effect of nickel upon iron is shown by this research, as even though ordinary nickel steel becomes brittle, it does so to a much less extent than carbon steel. It would appear, therefore, that iron, a cheap and convenient metal itself, must be permeated or alloyed in the mass with some alloy to modify its properties.

The German iron trade has suffered a severe loss by the death, on May 5th, at Düsseldorf, of Dr. Carl Lueg, head of the Gutehoffnungshütte steel works, Oberhausen. He was a member of the Iron and Steel Institute, and for more than a quarter of a century president of the Society of German Ironmasters. On the occasion of the celebration of the completion of the 25th year of the existence of that society, on April 24th, 1904, a Carl Lueg gold medal was instituted to be awarded for conspicuous services to German metallurgy. The first award was made to Carl Lueg himself. The German Emperor made him a Privy Councillor, and the town of Oberhausen made him a freeman. He was a member of the Prussian Upper House, and was one of the organisers of the successful Düsseldorf exhibition.

We are becoming accustomed to naval scares, and the latest note of alarm comes from Lord Ellenborough, retired Commander R.N., who read a paper at the Royal United Service Institution on Tuesday on the possibility of our fleets and harbours being surprised. Admiral Togo's attacks on Port Arthur, he said, furnished a lesson to Portsmouth and Portland. If simultaneous attempts to sink our battleships, the positions of which were shown on charts that could be bought for a few pence, and to block our harbours were successful, the enemy might then be able to protect his transports from torpedo attacks and so reinforce an invading army. We were in far greater danger of attack when all our fleets were assembled at Spithead for a naval review than on any other occasion. Lord Ellenborough advocated that all the forts that protect our naval anchorage should be constantly kept on a war footing ready to open fire, that a post captain should be on duty night and day at the Admiralty, and that no pilots except those British born should ever be allowed to exercise their profession on our coasts. Many of our readers will doubtless agree with Admiral Sir N. Bowden-Smith, who, in the course of the ensuing discussion, said he considered the possibilities of surprise were exaggerated. One can the better appreciate the exact importance of the latest naval scare on reading that to the same audience Lord Ellenborough prophesied disaster from the freedom of the English press.

Winding engines of high power have only lately been erected at one or two Westphalian collieries, but electrical power has been extensively applied for haulage purposes. An elaborate electric plant, has recently been erected at the Zollern II. colliery, the feature of this installation being the exclusive use of continuous current and the shunt regulation of the motors. The winding engine is at present bringing 1,200 tons of coal in 12 hours from a depth of 918 ft.



# PAGE'S WEEKLY

An Illustrated Technical Weekly, dealing with the Engineering, Electrical, Mining, Iron and Steel, and Shipbuilding Industries.

**DAVIDGE PAGE, Editor.**

Clun House, Surrey Street, Strand, London, W.C.

Telephone No: 3349 GERRARD.

Telegraphic and Cable Address: "SINEWY, LONDON."

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## New Copy for Advertisements,

Alterations, &c., intended for insertion in the current week's issue must be delivered **not later than 4 p.m. on Monday**. If proofs are required the copy and blocks should reach us several days earlier.

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## MEETINGS FOR THE ENSUING WEEK.

**FRIDAY, MAY 12.**—Iron and Steel Institute, Annual Meeting, 10.30 a.m.; Annual Dinner, Hotel Cecil.—Railway Club, 7 p.m.: Paper on "Modern Methods of Working Passenger Traffic," Mr. R. E. Charlewood.—Royal Institution: Lecture, Professor Ernest Fox Nicholls, "Pressure due to Radiation."—Physical Society, Royal College of Science, South Kensington: "A Simple Method of Determining the Radiation Constant: suitable for a Laboratory Experiment," by Dr. A. D. Denning; "A Bolometer for the Absolute Measurement of Radiation," by Professor H. L. Callendar; "The Resistance of a Conductor and the Measure of the Current Flowing through it," by Mr. W. A. Price.

**SATURDAY, MAY 13.**—Junior Institution of Engineers, Visit to Dorking Water, Gas and Electricity Works, train Cannon Street at 1.30 p.m.

**MONDAY, MAY 15.**—Society of Arts, Cantor Lectures: "The Uses of Electricity in Mines," Two Lectures, Mr. Henry W. Ravenshaw.

**WEDNESDAY, MAY 17.**—Chemical Society, Burlington House, 8 p.m.—Society of Arts, Ordinary Meeting.

**THURSDAY, MAY 18.**—Institution of Mining and Metallurgy, Conversation, Professor Dewar, "Flame" Lecture II., 8 p.m.—Royal Society, Burlington House, 4.30 p.m.

**FRIDAY, MAY 19.**—North-East Coast Institution of Engineers and Shipbuilders, Newcastle.—Royal Colonial Institute.—Anniversary Dinner, Hotel Metropole.—Royal Institution, 9 p.m.; Lecture by Sir Charles Elliot, K.C.M.G.

## NEWS ITEMS.

Natal's monthly coal output has amounted for the first time to more than 100,000 tons, the actual March figures being 108,000.

The new Victoria blast furnace at the Ebbw Vale Works in a recent week turned out 2,320 tons of iron, which is said to be the highest output of any single furnace in England and the second highest in Europe.

The annual Conversazione took place at the Institution of Mechanical Engineers yesterday. This is a popular function, and a large company which included many ladies, accepted the invitation of the President and Council.

Mr. C. T. Yerkes has resigned the chairmanship of the London United Tramways in order to devote more time to the Metropolitan District Railway Company. Mr. Charles James Cater-Scott has been appointed to fill the chair thus vacated.

In the Transvaal Government Mining Engineers, recent report, comment is made on the growing use of belt conveyors in the mines. During the past year the continuous mechanical haulages have increased twenty-five in number, and 405 h.p. These are nearly all conveying belts.

Messrs. William Gray and Co. Ltd., shipbuilders and repairers of West Hartlepool, will be making an issue at par of £350,000 4½ per cent. 1st mortgage debentures of £100 each, at the end of the week. The firm is one of the largest of its kind, the average profits, during the last sixteen years, having been over £94,000. The debentures are a specific first mortgage on all the company's property and plant, and a floating charge on all other assets.

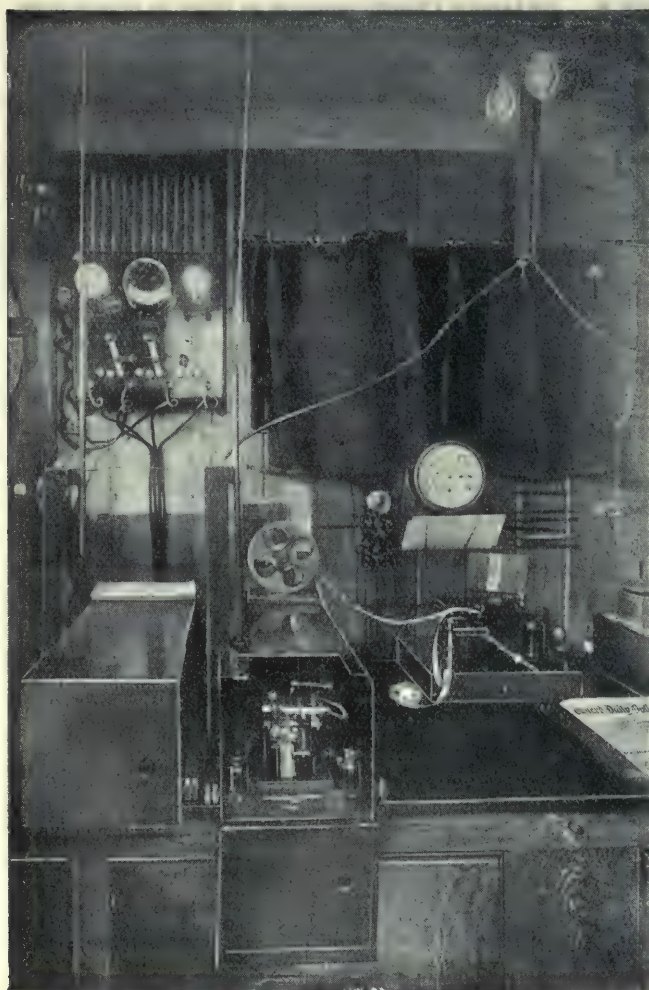
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### Marconi Cabin on Board the "Caronia."

Our illustration shows the interior of the Marconi cabin fitted on board the Cunard liner *Caronia*, where it is carried forward on the boat deck. The successful consummation of this enterprise in Cunard liners has been the subject of universal congratulation, alike to the inventor who has rendered "Marconigrams" possible, and the steamship company. The Cunard Daily Bulletin, a few early numbers of which we treasure as a journalistic venture of no ordinary interest, gives its readers the important news of the day in a nutshell, and entirely disposes of that feeling of aloofness which once marked a trip across the Atlantic. The latest war news, items of industrial interest from both sides, news from sister ships, etc., find a place in this unique newspaper,



MARCONI CABIN ON BOARD THE CUNARD LINER "CARONIA."

which has even its stop-press, in which we read, for instance, whether Lancashire defeated Middlesex or Yorkshire drew with Surrey.

### A Transvaal Appointment.

An interesting engineering vacancy occurs at Johannesburg, where a general manager to take charge of the entire tramway, light railway, and power undertakings, is required, at a salary of £2,000. A station engineer is also to be appointed at a salary of £1,000.

### Springfield Armoury.

By courtesy of the Commanding Officer, illustrations of the Springfield shops appear on page 1023. Those known as the Water Shops—about a mile from the Administration building—are run by water power, while the "Hill" Shops are run by steam. At this armoury at the present time over 1,800 men are employed in the manufacture of the service rifle, and here also the new service sabre is made. The Springfield Armoury was recently described by Colonel Cubillo in PAGE'S WEEKLY.

### "Unor" Steel.

Mr. P. R. Kuehnrich, of Sheffield, has produced a new form of steel, to which the name "Unor" has been given. He claims that it will revolutionise the air hardening steel industry. According to a description, which has received the official confirmation of Sheffield Steelmakers, Ltd., who are putting the new steel in the market, its cutting and wearing capacities range between that of the original Mushet self-hardening steel and the best of the modern high-speed steel. The treatment required to manufacture tools from steel of this description has established a record for simplicity. All that is necessary to harden it is to heat it to a bright red, and not beyond the "critical point," as is the case with current types of high-speed steel; and to allow it to cool naturally in the air without the use of an air blast. The obviation of the use of an air blast simplifies the process greatly. To anneal "Unor" steel for easy machining all that is required is to heat it to a cherry red, let the heat sink over the fire to a very dark red, and then to plunge it in the water. Experiments have proved that it can be rehardened or softened any number of times, and that the wearing quality of the new tool material does not deteriorate in any way in the course of these processes.



# IRON AND STEEL INSTITUTE.

## ANNUAL MEETING.

THE annual meeting of the Iron and Steel Institute opened on Thursday at the Institution of Civil Engineers, under the presidency of Mr. R. A. Hadfield.

The following details are from the annual report in which the council recorded that during the year the Institute had again made very satisfactory progress.

During the year 1904 there have been added to the register 213 names. The number of members on the roll of the Institute on December 31st, 1904, was:—

Patron .. .. .	1
Honorary members .. ..	11
Life members .. .. .	27
Ordinary members .. ..	1871
Total .. .. .	1910

The growth of the Institute during the past thirty years is shown by the following statistics:—

	1874	1884	1894	1904
Patron ... ..	...	...	...	1
Hon. Members ... ..	...	5	5	11
Life Members ... ..	...	...	...	27
Ordinary Members ... ..	777	1285	1429	1871
Totals ... ..	777	1290	1434	1910

During the year 1904 the Institute suffered heavy losses by the death of well-known members, among whom were several active contributors to its work. The list comprises forty-one names, including Sir Lothian Bell, Bart., Messrs. A. H. Allen, E. Bertrand, H. Le Neve Foster, and F. Siemens.

The financial prosperity of the Institute was a matter for congratulation. The income for the year amounted to £5,666, and the expenditure to £5,727. The expenditure included a subvention of £200 to the National Physical Laboratory. The excess of expenditure over income was caused by the publication of a supplementary volume of the journal.

The report contained a list of the twenty-one papers contributed to the proceedings during the year, details of awards, the two meetings of the Institute, the visit of the Belgian engineers, and other matters which had been chronicled from time to time in PAGE'S WEEKLY.

### PRESIDENT'S ADDRESS.

Much interest centred in the presidential address, which covered a wide field and must certainly rank as one of the most interesting in the annals of the Institute. The following is an abstract:—

The Institute had sustained since its last meeting an irreparable loss in the death of one of the founders, Sir Lowthian Bell, whose life's work might be said to represent the modern development of metallurgy.

Four of their Past-Presidents had been from South Wales, four from Middlesbrough, and one from America. This was the first time his own city had been represented, and he felt his election to that honourable office, as not only a compliment to himself, but to that great and historic home of steel where, under Huntsman, the modern art of making cast steel originated.

### VISIT TO SHEFFIELD.

Although the Institute had never yet visited Hallamshire, he hoped during his term of office to have the pleasure of welcoming its members there, and assured them that the metallurgists of Sheffield would offer them all a most hearty and cordial reception.

### AN INTERNATIONAL PORTRAIT GALLERY.

*A propos* of the collection of portraits of early workers in metallurgy, included with the address, Mr. Fremont and Mr. Osmond had made the valuable suggestion that an international portrait gallery of men of science, past and present, should be formed. He hoped this excellent idea would ere long be carried into effect.

### PROPOSED FEDERAL IRON AND STEEL PARLIAMENT.

The Council comprised, besides its British members, representatives from America and Belgium. This representation of countries other than Great Britain might be further widened, so as to include representatives from our dominions beyond the seas, and from other important industrial nations. Such a step would doubtless be of benefit to their deliberations. A federal Iron and Steel Parliament representing the whole of the metallurgical world, having branches and meetings from time to time in other countries, would surely help to further the wise ideal of their last President as to the spread of "Internationalism."



**35,000 PAGES OF TECHNICAL MATTER.**

The most important function of a technical society was the reading and discussion of papers. They had issued sixty-six volumes of Proceedings, containing 686 original papers and about 35,000 pages of matter. This represented practically the history of the iron and steel industry for the last thirty-six years. Thanks to the excellent editing by their secretary, Mr. Bennett H. Brough, not only was the high character of the contents of their volumes maintained each year, but they even became of increasing value. Last year no less than 2,309 abstracts were prepared by Mr. Brough, whose technical and scientific knowledge had proved invaluable to the Institute. He suggested that a simple and inexpensive arrangement for the full translation of foreign articles would be of great advantage.

After a tribute to the technical press the President discussed the best method of making the mass of literature available for individual needs. The decimal system of classification seemed to be the best yet introduced for technical subjects, and every one interested in special subjects of various kinds should bear in mind that a simple method of meeting individual wants, and one easy to be adopted, was to start a card index of one's own.

**RESEARCH THE LIFE BLOOD OF PROGRESS.**

As one who had carried out many researches in metallurgy, the President emphasised the practical importance of research, remarking that it was more than ever necessary not to rest satisfied with the knowledge of to-day, nor to think that this would satisfy the needs of to-morrow. Rapid and great changes were constantly occurring in metallurgy, as in other branches of scientific knowledge.

As showing the complexity surrounding research work it was pointed out that every single substance might be largely considered as a different body at every different pressure or temperature, and it was probable that every substance underwent a numerous series of molecular changes when gradually altered in pressure or temperature, although they had as yet detected only a few of them. The carbon compounds now definitely known numbered over 80,000, and the mineral, carbonate of calcium, was said to crystallise in upwards of 700 different varieties of form.

Let it be remembered that research was the very life-blood of progress, and upon the facts which it disclosed depended the true interpretation of science. The first place of honour in the modern evolution of science was due not to the men actuated by love

of gain or utilitarian views, but to the scientific investigator.

**THE TRAINING OF METALLURGISTS.**

After dealing with the predominance of Anglo-Saxons as inventors, the President came to the subject of metallurgy—considered as a distinct science—and the metallurgist. He did not, however, treat at length upon modern developments in metallurgy, as the ground has been covered by so many Past Presidents.

He remarked that the only possible way to make satisfactory progress in metallurgy was to combine the practical with the theoretical in the training of metallurgists. Rule-of-thumb methods no longer sufficed. Much of the mystery which had surrounded their science had been swept away; and rightly, for it is only by the intelligent application of scientific principles, balanced by and co-operating with sound practical knowledge, that the metallurgist could meet the complex requirements of the day.

As showing the important position occupied by the metallurgist, he remarked that metallurgical products—that is to say, iron and steel, including manufactures thereof—now occupied the chief position in the world's manufactures. The British share in this branch was probably at least £160,000,000, and the United States over America £360,000,000, Germany being considerably over £100,000,000.

The value of the world's production might be taken as about £600,000,000 of iron and steel, or a much greater figure with the after-products. It was estimated that metallurgists were concerned with an industry of which the total world's final production was considerably more in value than all the trade, import and export of this country.

**FUTURE OUTPUT.**

The immediate past of metallurgy had been great indeed in the enormous productive power which had been created, specially during the last twenty-five years; but should the nations of the East develop needs for iron and steel—and there was every probability that they might, during the present century—then outputs which now seemed to them immense would pale into insignificance. An Anglo-Indian, competent to judge, told him recently that it could not be long before India must have 100,000 miles of railway.

Supposing the whole population of the globe, now reckoned at over 1,500 millions, or say even two-thirds of this number, eventually called for as much iron per head as was now used by each inhabitant of America and the United Kingdom—about 560 lb. per head—





Mr. R. A. Hadfield,  
President of the Iron and Steel Institute.



Professor Oliver Arnold.  
*Photo, Elliott and Fry.*



Mr. James Gayley.

#### THE ANNUAL MEETING OF THE IRON AND STEEL INSTITUTE.

Mr. R. A. Hadfield's achievements in the metallurgical world and his discovery and commercial development of manganese steel are too well-known to our readers to need recapitulation. An abstract of his presidential address at the meeting of the Iron and Steel Institute on Thursday is published in the accompanying pages.

Mr. James Gayley, of New York, played a prominent part in welcoming the English iron-masters to St. Louis last year. His researches into the application of dry air blast have been the subject of much discussion, and a feature of prominent interest at the annual meeting was his supplementary paper on this subject.

To Professor Arnold the President offered hearty congratulations on the well-deserved award of the Bessemer Medal of this year, remarking that in his paper "On the Influence of Carbon on Iron" (1895) he set forth the proposition, now generally accepted by all metallurgists, that the saturation point of iron and carbon is that in which the carbon content is 0.85 per cent. to 0.90 per cent.

In view of the work that he has done upon the micro-structure of iron and its alloys, the mantle of Dr. Sorby may be said to have fallen upon him.



the demand would then rise to the figure of not far short of 300 million tons per annum. This, too, did not take into account the increasing demand per head. If a growth of universal demand took place, and there was every probability that it would, might not trouble then arise on account of the scarcity of ores? As there was no other equally useful metal in sight, husbanding of the world's resources would have to take place.

Although this might seem a resuscitation of the Jevons theory, but applied to iron, as it formerly was to coal, there must be good grounds for taking the view that, unless methods of economically working the vast sources of poor available ore were devised, at the end of the present century there would be an insufficiency of available iron ore, the seriousness of which it is difficult to estimate.

As was well known, iron ore existed largely on the earth's surface, and the fact supported Sir Robert Ball's theory that the sources of this noble metal must have been originally from without and not within the earth, in which case supplies could not reasonably be expected to be found below the surface. This was a view which, if correct, pointed to a narrowing of our supply.

#### THE CHEMIST'S PART.

One of the most important assistants to the metallurgists was, without doubt, the chemist, who may well be called his *aide-de-camp*. A modern metallurgical chemist had to take a wide range of view. He must not only be well gifted in the art of the laboratory at large, but must keep an intelligent eye upon the many ramifications of his special branch. The complex combinations now met with in alloys or special steels would be appreciated when it was remembered that there were often more than ten different and important elements in a single alloy combination. It was thus found that their present methods were not too reliable, and there was room for much more light in this direction. The subject was of such importance that if a special committee were formed to take up this matter it might do great service to the world at large whilst benefiting the metallurgist more directly. Such information would enable them to secure, unerringly, important practical results that were now obtained in far too haphazard a manner. They had at present, no means of properly determining these combinations by the method which should be the simplest, best, and most trustworthy—that is, chemical analysis. Mysterious failures still occurred, and one of the helps to solve this problem would be to know the full why and wherefore of the exact composition of steel. It was for these reasons, amongst others,

that he placed the responsibility of the metallurgical chemist so high. When once the latter recognised what was needed from him, he would, they might be sure, rise to meet the want, as he had done in the past.

#### RAW MATERIALS—ORES.

As iron pure enough for use was rarely found in the native condition its sources must be from its ores. These were, for their present needs at any rate, happily abundant. Although the supplies in this country were far from being illimitable, they are very favourably placed geographically to receive ores at low cost from many other countries. So long as they had cheap freight their iron trade was capable of any reasonable extension. As would be seen from the diagrams, if the relative past ratio of increased production of iron continued to the year 2000, at least 450 million tons per annum of iron ore would be needed.

Statements had been recently made that the iron sands of New Zealand, as well as those of Canada, would soon form another large source of supply, but until a satisfactory method of smelting and reducing this sand to marketable iron was discovered nothing could be accepted definitely as to its value.

#### PIG IRON—FUTURE REQUIREMENTS.

Pig iron was the basis, and likely to continue to be so for some time to come, of all iron and steel, and the world's consumption of this metal could readily be ascertained. In fifty years the production of pig iron had increased from figures which they now regarded as practically zero to over 50 million tons annually; and if demands arose in the Far East on a scale proportionate to that of the West, as was quite likely to be the case before long, it would not be an idle estimate to say 100 million tons of pig would soon be required annually.

There was nothing of special value to chronicle as regards improvements in the production of pig iron. Blast furnaces with enormous capacity continued to be the order of the day, and it was proposed to follow American practice in this country; although it was held, in some quarters, that there was evidence, for a time at least, that the limit had been reached, yet the experiment would be watched with much interest.

Mr. Gayley's plan of drying the air used in blast-furnaces was also likely to prove an important advance; if the savings and advantages claimed could be sustained in continuous practice, there was no doubt a great future for this method. Mr. Heurteau and Mr. H. Le Chatelier seem to think, however, that the saving effected by drying the air could not exceed more than about 3 per cent. instead of the 20 per cent. claimed,



and that the explanation of the difference was yet to be sought.

#### SUPPLY OF IRON AND ORES.

As the question of the present rate of consumption of iron, and also its past and future production were of considerable importance, the President had prepared a number of diagrams dealing with these points, several of which are reproduced herewith. Diagram III. shows the production of iron, advancing by periods of twenty-five years, since 1800. The total production since that year to the end of 1904 is shown by fig. 8 in the same diagram. Approximately, this amounted to 1,100,000,000 tons. It was pointed out that we still occupy the first position as regards total or aggregate production of pig-iron, having produced more iron over the whole period than any other nation during the past century. The figures are: United Kingdom, 400,000,000 tons; America, 250,000,000 tons; and Germany, 170,000,000 tons.

The President next considered the question of the future. The full lines in diagram I. (page 1008), represented, actual production from the year 1800 to 1904; the dotted lines showed the estimated production in the years 1950 and 2000, based upon the supposition that the increase would continue in the same ratio as during the past thirty years. By the end of the present century, it was quite within the bounds of possibility that the large total mentioned in diagram I. as to probable annual requirements was not so far from being correct as might at first sight appear.

#### SOURCES OF SUPPLY.

This at once raised the important question: From whence would come all the vast store of ore needed?

Fortunately, iron ore was plentiful; but would it stand for long the enormous drain upon it? Since 1800 about 3,300,000,000 tons had been used up; in the next hundred years no less than about 15,000,000,000 tons would be needed, even if no allowance were made for increase of consumption. Assuming that the rate of increase indicated by diagram I. took place, then about 30,000,000,000 tons of iron ore would have to be taken out of the ground during the present century.

By the year 2000, 450,000,000, tons of ore would be required annually. Such a consumption, if it continued for a century only, would need no less than 45,000,000,000 tons. Such a rate would quickly exhaust all the present known supplies of the world.

If, in a few centuries, there was likely to be lack of iron ore, it greatly concerned them to watch this question. The possibility also showed the importance of metallurgy, and the necessity for encouragement of its scientific study, so that every reasonable economy

in the use of this valuable metal might be fostered. It proved, too, that the man who could make one pound of iron go as far as two pounds do now was also a benefactor to mankind, and it followed that a knowledge of special steels, which were really economical steels, was of the highest importance.

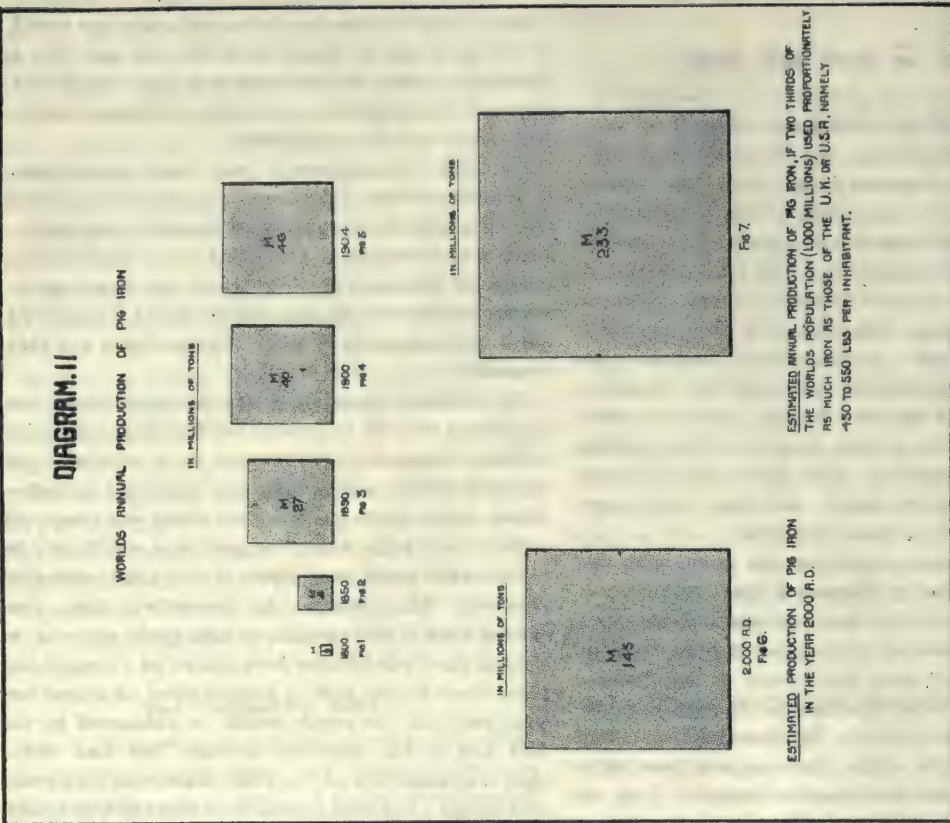
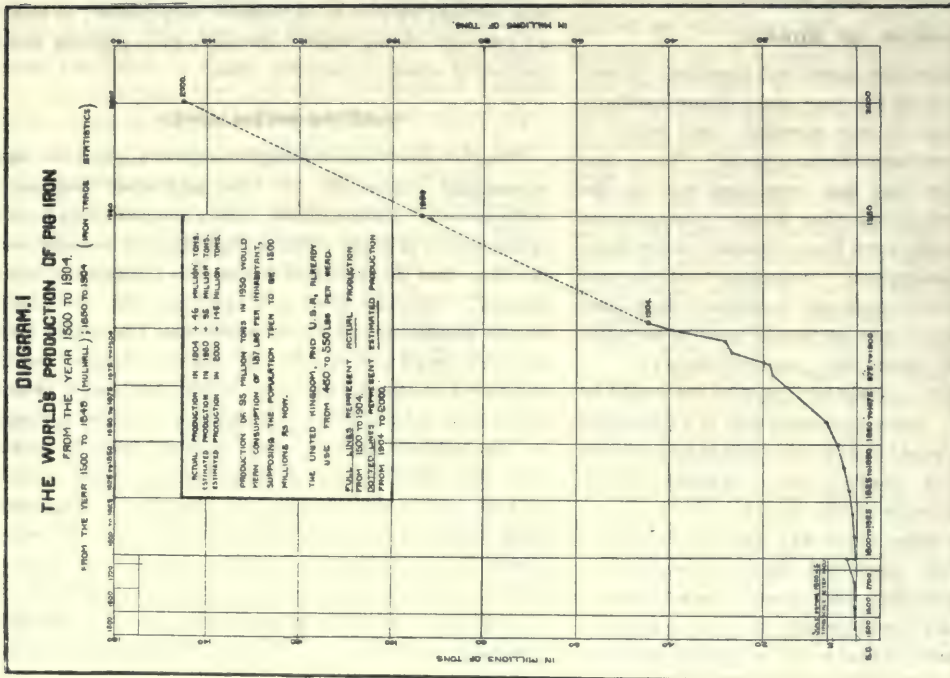
The curve in diagram I. was really astonishing. It pointed out that the increase in production during the years 1860 to 1904 was continuously progressive. There was no reason to think this curve would either remain at the same level, or would dip down again. It must continue to rise, but whether at the rate pointed out it was impossible to say. His own belief was that it would.

Reviewing the estimates of various authorities as to the supplies of iron ore he pointed out that these were more or less conjectural. For instance, it is quite probable that in Lorraine, and in their own Cleveland district—where several years ago the mass of ore was computed to be 5,000,000,000 tons—the good ores would only be a relatively small proportion of the total estimated resources. Dr. Carnegie, in November, 1902, considered that if the amount of high-grade material in sight in the United States were placed at 1,000,000,000 tons, then, at the rate of consumption of 20,000,000 tons per year, the supply would be exhausted in the first half of the twentieth century. He also stated that the exhaustion of the then discovered high-grade ores within a few decades was little short of a certainty. It was also pointed out that the waste in producing and working up iron is, at present, very heavy; at least 23 per cent. being wasted annually in a pig-iron production of about 50,000,000 tons.

#### ELECTRO-METALLURGY.

Whether electro-metallurgy could be applied to the economical production of iron and steel remained to be proved. Unfortunately, there seemed to be fixed in the minds of some of those exploiting such processes the idea that all steel now made, was radically of bad quality. This, he need not say, was not the case. It was wonderful how modern steel met the varied and complex requirements of the times. Besides, with the alloys of iron and carbon, which they called steel, it mattered little in what form fusion took place, so long as the product gave off the analysis needed. Cost was the chief practical consideration. Mysterious virtues had been claimed for electrically produced steel, but its very freedom from some of the elements which it was desirable should be present had been a defect. The Canadian Government appointed a Commission to report upon various electric smelting processes, and their report stated that electric energy





need be very cheap indeed to enable these processes to compete at all with the blast furnace. In fact, such methods might be termed, at any rate for the present, not practicable; so that blast furnace owners could breathe freely.

#### MANUFACTURE OF ORDINARY STEEL

Improvements in the manufacture of steel had been of late in the direction of producing new types, and in methods of treating, working, and using these new types, rather than in processes of manufacture. The handling



of enormous steel plants in America had been in connection with comparatively old systems, which, in themselves, remained much as they were many years ago. Changes which had occurred had related chiefly to improvements in machinery rather than to processes. Although modifications of minor importance were gradually being introduced, it was difficult to see where further radical departures could take place in existing processes themselves or in the machinery employed. It was rather to the material produced that attention was now being specially devoted. They were told that American practice was now to "squirt"—it can hardly be called rolling—rails through the mills at the rate of 15 ft. per second, or over 10 miles per hour, but wonderful as this was, it was only an improvement in practice and not in principle. The Talbot continuous method, the Bertrand-Thiel process each found supporters, but important as these were, they were in the main modifications of systems long at work—i.e., they involved no important new principles. With regard to the Talbot furnace, one used by the Jones and Laughlin Steel Company, Pittsburg, had produced, in four months, 21,000 tons of steel, exceeding by 3,000 tons the previous best record. The furnace was operated continuously for four months, only going out of use for repairs.

#### STEEL-MAKING IN JAPAN.

Their friends the Japanese, with characteristic enterprise had taken up the manufacture of steel, and although their Government Works had not been altogether successful, there was no doubt that in time they would prove of great service in supplying local requirements. One of the Government Works, Wakamatsu, the largest undertaking of the kind in the country, had manufactured, during the year, over 30,000 tons of steel rails. These works were in the neighbourhood of an abundant coal-producing district, and were conveniently situated for the importation of iron ore from China.

#### DISCOVERY OF MANGANESE STEEL.

Considerable attention was devoted to the subject of alloys of iron with other elements, and as regards the discovery of manganese steel, the President remarked that he did not think that any record of systematic work of this nature had appeared before he read in 1888, a paper on "Alloys of Iron and Manganese," before the Institution of Civil Engineers. This paper represented several years of laborious research work, which showed that it was quite impossible to predict the qualities of any particular combination of iron with another element, except by actually testing each varying percentage from the lowest to the highest. In other words, because, as was before well known, a

small percentage of manganese made iron brittle, it did not follow that three or four times that amount would not give quite another and absolutely different product, as indeed proved to be the case. As the discoverer of the peculiar iron alloy containing 12 per cent. to 14 per cent. of manganese, he confessed that it was not a little satisfactory to discover a malleable non-magnetic iron alloy, differing in its mechanical, electrical, and other properties from any other iron alloy then known. It was true that Mushet had previously noticed that spiegel was non-magnetic, but this product was non-malleable, and, in many other respects, had properties totally different from those of the manganese-iron alloys with which he had worked.

#### PROFESSOR ARNOLD.

After paying a tribute to other workers, the President said that not less valuable had been the classic work of Professor Arnold—to whom they offered most hearty congratulations on the well-deserved award of the Bessemer Medal of this year. In his paper "On the Influence of Carbon on Iron" (1895), he set forth the proposition, now generally accepted by all metallurgists, that the saturation point of iron and carbon is that in which the carbon content is 0.85 per cent. to 0.90 per cent. Not less important had been his further papers on "The Micro-Chemistry of Cementation," "The Physical Influence of Elements on Iron," and "The Diffusion of Elements in Iron." To this record must be added that of his accurate research work in microscopy. In fact, the mantle of Dr. Sorby

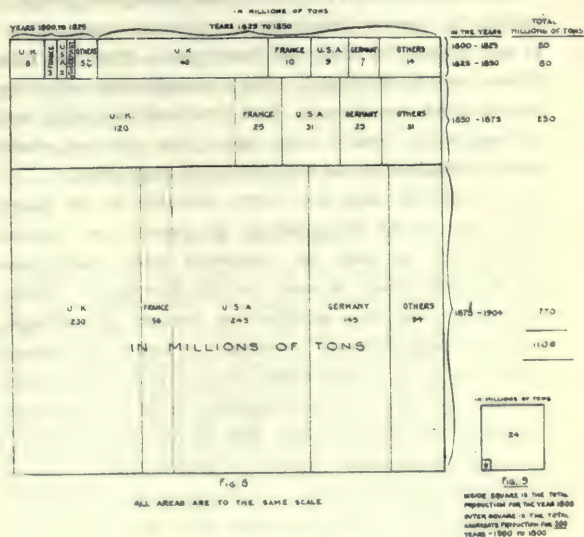


DIAGRAM III.

The total production of pig iron from 1800 to 1904 was 1,100 million tons. Comparison of production on each 25 years, 1800 to 1825, 1825 to 1850, 1850 to 1875, 1875 to 1904.



might be said to have fallen upon him, seeing the work he had done on the micro-structure of iron and its alloys. Though an enthusiastic microscopist, his judgment had shown him that, whilst the microscope was an important adjunct in research work, it must be used correlatively as one amongst several means for solving metallurgical problems.

#### HIGH-SPEED TOOL STEEL.

In America, Messrs. Taylor and White, by their researches, not only upon the composition of steel, but also upon its treatment, had shown how to apply some of these special steels to important uses, including the production of high-speed tool steel; a subject upon which great advances had been made lately. To these investigators was largely due the important advance in practice from which to-day nearly every machine shop in the world was benefitting.

Mr. Gledhill had shown that with this steel turning can be done, in certain cases, at the rate of 500 ft. per minute; a wonderful advance on past practice. High-speed tool steel was most difficult to produce, the waste, cost of rolling, and preparation being very high; and the rarer elements which have to be used necessarily made the material costly, if it were to be trustworthy. It was satisfactory to find that Sheffield still maintained its ancient renown by the advances it had made in this new and important branch of industry. If alloy steel were taken away there would be an end of progress, so much did advancing civilisation depend upon the work of the modern metallurgist.

The importance of the class of metallurgical products known as special ferro-alloys was now very great. It was largely by their aid that special steel and iron alloys could be produced. Ferro-manganese containing 80 per cent. manganese, first produced in 1875, and costing, even twenty years ago, £100 per ton, could now be obtained for about one-tenth that price.

Ferro-silicon was now very valuable in its many uses, and could be obtained of almost any desired percentage, as well as combined with manganese in the ferro-alloy known as silicon-spiegel. Ferro-chromium was also supplied of various percentages, and at comparatively moderate prices; the almost pure form of the metal itself was produced by the Goldschmidt process. Ferro-tungsten, ferro-molybdenum, and ferro-vanadium, might also be obtained, although owing to their greater rarity, at higher prices. Nickel and ferro-nickel were now made on a large scale, and at reasonable rates, compared with the almost prohibitive prices of but a few years ago. Many of these special ferro-alloys were being largely produced, by means of the electric furnace, in France, in America, in Canada, and elsewhere.

#### HEAT TREATMENT.

One of the most important branches of the metallurgy of iron and steel to-day was that relating to heat treatment; and in using the term he was here referring to something apart from heat treatment for hardening purposes. Why, it might be asked, was heat treatment found to be so important? It was because on the temperature employed to produce a particular condition in the steel rested the final physical and mechanical properties of that material. For example, a nickel-chromium-iron alloy as forged, might appear to be of no commercial value, but by judicious heat treatment with or without quenching in oil or water, its elastic limit might be made to vary from 22 to 60 tons per square inch, its tenacity from 40 tons to 96 tons per square inch, and its ductility from 8 per cent. or 10 per cent. to 30 per cent. or 35 per cent. They still understood but dimly why these effects were produced; but in the main, no doubt, they were owing to resultant variations in the form of the carbide, or hardening carbon, present, or to almost infinite shades of conditions or combinations of the two. Seeing that there were now already more than 80,000 different carbon compounds known to exist, the extraordinary and marvellous influence and power of carbon, when alloyed with iron, need not be a matter of wonder.

Whilst other metals are affected by variations in temperature, not one of them seemed so sensitive as iron and its alloys. It is stated that even the temperature of boiling water at atmospheric pressure would gradually soften hardened carbon steel; certainly at 200 deg. C. changes occur.

#### METALLOGRAPHY.

It was not often that the real pioneer of an important advance could be so clearly indicated as in this case; but the metallurgists of the whole world had generally admitted that they were indebted to one of Sheffield's citizens, and a member of this Institute, Dr. H. C. Sorby, for this valuable aid to metallurgical research. There had, unfortunately, been a tendency to multiply the names of micro-constituents. Owing to the many varieties of structure met with this had been, to some extent, unavoidable; but many of these names gave a wrong impression to the student, although the constituents had been usefully defined. The currently accepted designations of the various constituents of steel used in metallography must be taken with some caution, as there was at present much difference of opinion as to their meaning.

#### LOW TEMPERATURE EXPERIMENTS.

The President mentioned that he was presenting to the Institute a full record of the results of the recent low temperature experiments carried out with the help



of Sir James Dewar. To him they seemed to throw very important light upon a number of difficulties in connection with the behaviour and properties of alloy steels. If their work had proved no more than one point alone, that of the remarkable influence of nickel upon iron at the low temperature of  $-182$  deg. C., they would have been amply rewarded for their joint research, and for the time devoted to the subject. Practically, at this low temperature pure iron had its tenacity more than doubled; its well-known ductility fell very low; its magnetic properties remained almost the same as at higher temperatures. This represented the general behaviour of all the alloys excepting those containing nickel, which were less affected, as regards loss of ductility, whilst an iron alloy containing 5 per cent. of manganese and 25 per cent. of nickel had its extraordinary ductility about 60 per cent., still further increased, and the tenacity also largely increased. Manganese steel had its ductility lowered, but its non-magnetic properties remained apparently unaffected. The whole of the results combined to offer a most interesting field for observation of the physical properties of iron, both at ordinary and at liquid air temperatures.

#### THE FOUNDRY.

The President considered that there was need for better systems of keeping cost in modern foundries. Much absurd and ruinous competition in foundry productions would cease if due attention were paid to this subject. There was also need for the education of foundrymen. This side of technical industry had hitherto been relegated far too much to chance. No one wished to decry the value of experience, but there was no reason why ordinary foundry managers and foremen should not occupy a position equal to that of the mechanical engineer.

The recent suggestion, made in America, of having a training school for foundry foremen, with a view to increasing their knowledge in mechanics and metallurgy was an excellent one.

#### CAST IRON.

As in other branches, it was found here that difficulties met with in the past could be largely solved by the aid of scientific methods. By taking in hand vigorously the chemistry of cast-iron in foundry practice it had been shown, especially in America, that the old systems of working must be cast aside, to be supplanted by scientific methods once unthought of. It might be noticed, therefore, with great satisfaction, that similar steps were being taken in this country to improve the technical side of this long-neglected industry.

More attention was now paid to the chemical com-

position of pig irons used for producing castings. The old and often misleading idea of working by fracture had been found to be quite unsuitable for modern requirements. Proper and systematic methods of making analysis, and of taking transverse and tensile tests, had been found to give valuable information, with the result that castings could be produced of much more uniform quality than formerly.

#### STEEL CASTINGS.

There seemed always to have been a glamour over the practice of steel casting. Probably more heart-breaking and disappointment had occurred in the exercise of this art than in any branch of steel industry. Happily, however, many difficulties have been overcome; and though the industry was still one requiring more than usual care and skilful management, the satisfactory advances made during the last decade had been of the highest importance.

The great advantages derived from the use of aluminium and silicon, as solidifiers, had enabled most of the defects due to unsoundness to be overcome. Increasing knowledge of the analyses and qualities of the various sands and fire-resisting materials used in moulds had been equally important. A range of product, varying from that having a ductility almost equal to that of soft forged steel, up to the hardest type was now readily obtained.

Many of the difficulties still met with would be largely overcome if the engineer would consult the steel founder when preparing his designs and patterns. Slight differences in design would ensure the production of a casting in steel, which could not otherwise be satisfactorily made; in other words, the steel might be of the best, the mould properly prepared, and yet all be entirely spoiled by failure to appreciate the necessity for adapting, as far as practicable, the design of the article required to suit the peculiar nature of fluid steel.

#### WAR MATERIAL.

Some interesting pages were devoted to war material. In the construction of guns, carbon steel had long held its own. Naturally, the risk of the gun bursting had necessitated great caution in the production of the material to be used. Special steels had been regarded with suspicion, but there was now a growing disposition to consider the question of using a special steel having higher efficiency as regards resistance to the severe stresses met with, and also to erosion. Attention was also being given to the means for avoiding "streaky" steel, which in the past had given much trouble.

In order to afford an exact idea of the enormous energies which have to be dealt with, it was mentioned



that a 12 in. breech-loading gun had been fired in this country with a muzzle-velocity of close upon 2,700 foot-seconds. This meant a striking energy of 42,220 foot-tons. The projectile, if uncapped, would be capable of perforating 44 in. of wrought-iron, 34 in. of mild steel, 19 in. of Krupp-cemented armour; if a capped projectile were used, about 23 in. of Krupp-cemented armour would be pierced. As might be imagined, the inner tubes of guns, at such velocities, were soon worn out; in fact, in large calibre guns, an improved steel for these inner tubes was a matter much to be desired.

Some attention was also devoted to testing, and the President included some hints to young members.

#### CONCLUSION.

In conclusion, he said, it was pleasant to be able to take office under conditions which seemed to indicate that the severe depression which had been universally felt was passing away and that better times were in store for industrial progress.

A careful survey of the markets had shown that much of the recent trouble came from the slackening of home demands (this no doubt partly consequent on the enormously heavy national expenditure), another proof of the greater value of home as compared with export trade. The worst was, however, now over. South Africa, Canada\*, Australia, and India were all planning and carrying out on a large scale more railways and other important schemes of various kinds. The same applied to America, whether as regards the United States or the Southern Continent. Egypt was engaged in the largest irrigation scheme of modern times; the Panama Canal would now probably go through; Germany was busy with home improvements; and if only the terrible war-cloud in the Far East could be dispersed, there was no doubt the world would enter upon an era of prosperity of which probably it had never before seen the like.

#### THE PAPERS.

The papers submitted at this meeting were as follows: "On Experiments on the Fusibility of Blast Furnace Slags," by O. Boudouard, D.Sc., Carnegie

Research medallist, 1903 (Paris); "On Recent Developments of the Bertrand-Thiel Process," by J. H. Darby (Brymbo), and G. Hatton (Brierley Hill); "On the Application of Dry-air Blast to the Manufacture of Iron," by James Gayley (New York), supplement to paper read on October 26th, 1904; "On the effect produced by Liquid Air Temperature on the Mechanical and other Properties of Iron," by R. A. Hadfield, President; "On the Cleaning of Blast Furnace Gas," by Axel Sahlin (London); "On the Failure of an Iron Plate through Fatigue," by S. A. Houghton (London); "On the Continuous Steel-making Process in Fixed Open-Hearth Furnaces," by S. Surzycki (Czenstochowa, Poland); "On Accidents due to the Asphyxiation of Blast Furnace Workmen," by B. H. Thwaite (London); and "On the behaviour of the Sulphur in Coke in the Blast Furnace," by Professor F. Wüst, Ph.D., and P. Wolff (Aachen). These will be dealt with in subsequent issues.

#### RESEARCH WORK.

Reports on research work carried out during the past year were submitted by C. O. Bannister (London), J. Dixon Brunton (Musselburgh), H. C. H. Carpenter (Teddington), J. C. Gardner (Oldbury), G. Dillner and A. F. Enström (Stockholm), E. G. L. Roberts and E. A. Wraight (London), Frank Rogers (Cambridge), and Walter Rosenhain (Birmingham), Andrew Carnegie Research scholars.

#### CARNEGIE RESEARCH SCHOLARSHIPS.

Recipients of the Carnegie Research Scholarships for 1905 are as follows: Henry Cook Boynton, D.Sc. (he studied at Harvard University, where he is now lecturer on metallurgy); Pierre Breuil (director of the testing laboratory of the Conservatoire des Arts et Metiers, Paris); Henry Cort Harold Carpenter (senior assistant in charge of the Metallurgical Department of the National Physical Laboratory); Leo Alexandre Guillet, D.Sc. (superintendent of the laboratories of the Dion Bouton works at Puteaux); William Herbert Hatfield (metallurgist to Messrs. J. Crowley and Co., Ltd., Sheffield); Edwin Gilbert Llewelyn Roberts (demonstrator in metallurgy at the Royal School of Mines); Walter Rosenhain (chief chemist and scientific adviser to Messrs. Chance Brothers and Co., Ltd., Birmingham); and Ernest Alfred Wraight (demonstrator in metallurgy at the Royal School of Mines).

(To be continued.)

\* Mr. J. Stephen Jeans, in his recent work on "Canada's Resources and Possibilities," had contributed some excellent information regarding our great Dominion, showing the wonderful future in store for it. The annual capacity of Canadian blast-furnaces was stated as being about one million tons of pig-iron, with a Bessemer and open-hearth steel capacity of nearly three-quarters of a million tons. America recognised that its Canadian trade would steadily diminish, and it was also to be expected that Great Britain would experience similar results



## THE BUILDING TRADES EXHIBITION.

### HORSFALL DESTRUCTOR COMPANY, LTD.

THE striking progress which has been made in the modern destructor within the last few years was made clear by the important exhibits in this class at the Building Trades' Exhibition, where the leading firms had stands. A short description of the refuse destructor recently installed at Luton by this firm may be interesting. The company has just completed the erection of a two-cell plant, designed to destroy 30 tons of ordinary house and market refuse per day when working at its full capacity, and of the type known as "Back-fed." For a small plant such as this, the important advantages of such an arrangement are fairly obvious.

The charging doors are at the back, and the clinkering doors at the front of the destructor provide for the complete separation of feeding and clinkering, which gives great facilities for the storage of surplus refuse against the hours of minimum delivery. The forced draught apparatus is on the Horsfall Company's new patent "hot blast" system.

Not the least important feature of this type of destructor is to be found in the patent centrifugal dust-catcher. This dust-catcher is a circular brick-work building, having 12 ft. external diameter, and something over 12 ft. in height. It consists of an outer chamber or shell, lined throughout with fire-brick, and in the centre of this is an inner chamber

communicating with the surrounding space at the top. The main flue from the destructor enters at the bottom of the external chamber, so that the gases have to pass round and upwards through the annular space before they enter the inner chamber, from the bottom of which they pass off to the chimney. There is a suitable pocket arranged to catch the dust, and provided with a cleaning door through which the dust may be drawn.

The dust obtained from the dust-catcher is a valuable asset, inasmuch as when mixed with about 10 per cent. of crude carbolic, it becomes an excellent disinfectant for town gullies, ashpits, etc. This is in itself a large saving as compared with the ordinary prices of disinfecting powders.

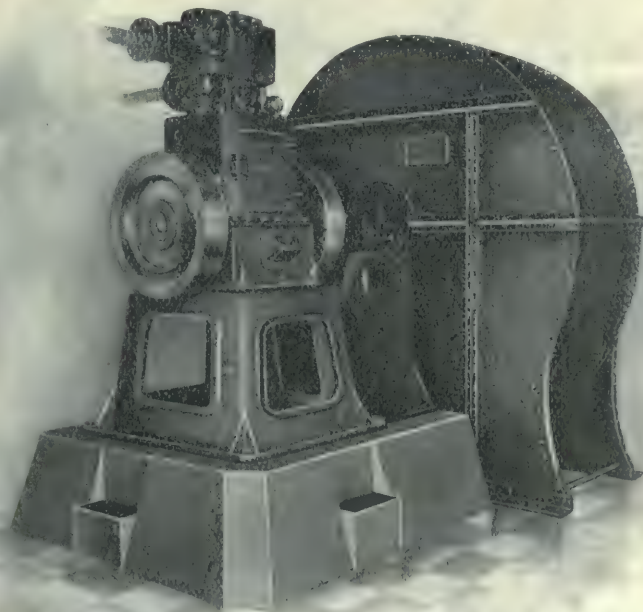


FIG. 1 A CYCLONE INDUCED DRAUGHT SET, COMPRISING NO. 10 CYCLONE BLOWER AND 7 IN. X 6 IN. CYCLONE HIGH-SPEED ENGINE.



**MATTHEWS AND YATES, LTD.**

The advantages of mechanical draught as applied to steam boilers is well worth the consideration of every steam user. With increased draught a greater quantity of fuel can be consumed on the same grate area, but the principal economy is claimed to lie in the fact that with mechanical draught a cheaper fuel can be used than with natural draught. The cyclone fans for induced draught with which the name of this firm is associated, are said to give highly satisfactory results. In fig. 1 is illustrated a new type, comprising a No. 10 cyclone blower, and 7 in. by 6 in. cyclone high-speed engine. This class of engine is the result of a large number of trials of engines of various types, is specially designed, and particularly adapted for driving fans and dynamos. It is entirely self-contained, and is of the smallest possible dimensions compatible with the ease in adjusting and cleaning, and the economical performance of the work it has to do. The steam consumption per b.h.p. in these engines is stated to be very low.

**ORENSTEIN AND KOPPEL.**

This firm exhibited one of its tank locomotives, an assortment of the tipping wagons of the type used by contractors, and other requisites of narrow-gauge

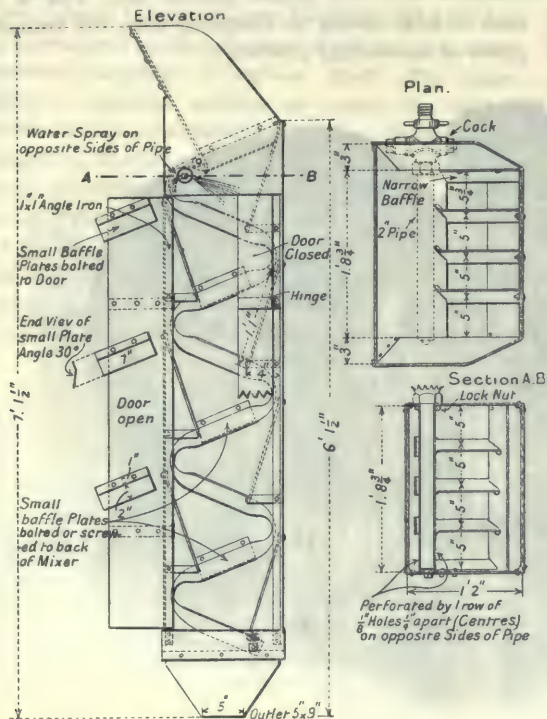


FIG. 2. ELEVATION, PLAN AND SECTION OF "PERFECTION" CONCRETE GRAVITY MIXER.

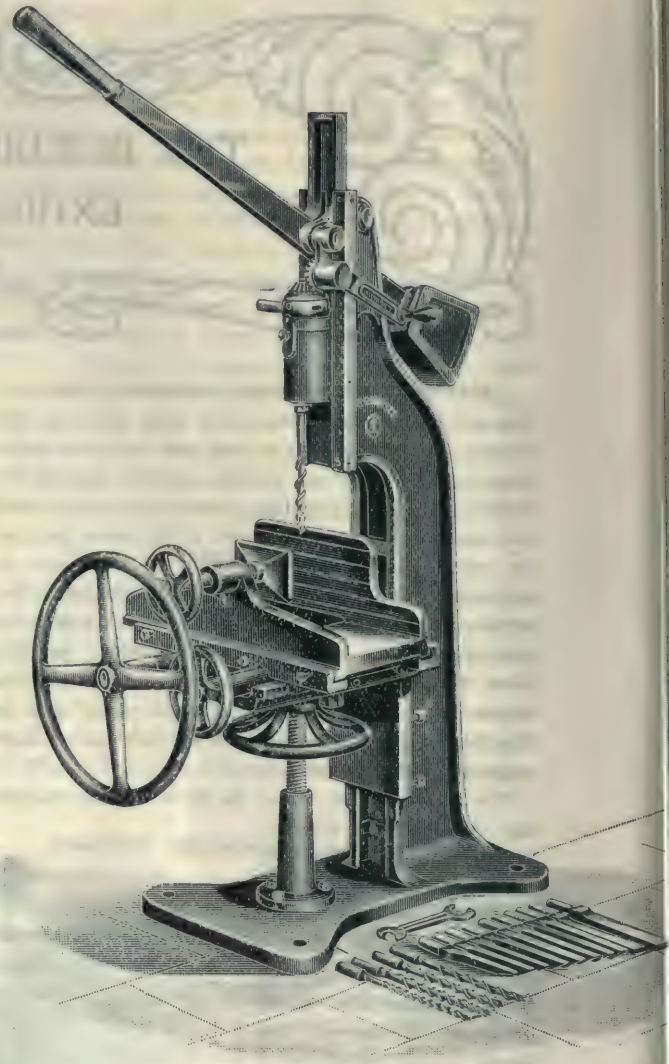


FIG. 3. CARRON HAND MORTISING AND BORING MACHINE.

railway plant. What attracted most attention, perhaps, was the "Perfection" gravity concrete mixture, illustrated in plan, section, and elevation, in fig. 2.

These three drawings show the general construction of the mixer, which consists of a steel shoot 7 ft. long, containing three sinuous bars of mild steel, eight large and six small baffle plates. The whole of the plates and bars are detachable, and can quickly be renewed. Provision for easily cleaning the mixer is made by means of a side hinge door. A regular and uniform supply of water is provided by means of a brass tube fixed behind the lower edge of the top baffle plate, and having a regulating cock attached.



This pipe is perforated both back and front by a row of holes  $\frac{1}{8}$  in. diameter, and  $\frac{1}{4}$  in. between centres. By this arrangement the whole of the baffle plates and also the sinuous bars receive a spray of water, thus providing a wet surface throughout the mixer for the materials to mix with while falling.

No driving power fuel, oil, etc., is required, as the concrete is mixed entirely by gravitation.

The method of mixing is as follows: The ballast is spread on a suitable platform at the front of the mixer, the sand and cement being then laid evenly on top and the material is shovelled steadily direct into the shoot. While falling the bars and plates deflect same and continually throw it from side to side of the mixer, with the result that before it reaches the exit at bottom it has been turned over eight times, and owing to the efficient water supply, the concrete is claimed to be thoroughly mixed and entirely free from slurry.

#### CARRON COMPANY.

The more purely engineering exhibits of this company include hand mortising and boring machines, and a drunk saw attachment, the former being illus-

trated in fig. 3. The main casting of the mortising and boring machine is of webbed section, having planed faces on the upper portion of the standard to take the spindle slide, and on the bottom portion to take the knee bracket and vice slides.

The spindle is of wrought iron, suspended by an accommodating link, and attached to the spindle slide by means of a wrought iron stud, thus delivering a direct blow through the chisel into the wood. The length of the stroke is 5 in., and the lever is maintained in a uniform position, irrespective of the size of wood to be mortised.

The boring attachment is fixed to the spindle sleeve by means of a link fitted to the pin which passes through the lever, and provided with a handle having a bevel pinion fitted to it, which gears into a corresponding bevel, placed on the top of the spindle close to the reverse handle.

By removing the screw pin in the slot of the reverse handle, and fixing it into the spindle sleeve, the spring pin is arrested and permits of the spindle being revolved for boring purposes. The handle is portable.

The vice admits wood up to 6 in. by 11 in., and the



FIG. 4. "PERFECTION" CONCRETE GRAVITY MIXER IN OPERATION.



slides have a horizontal and vertical adjustment. The lock motion is positive, reverses truly, and, being fitted to the spindle sleeve, is convenient.

#### HUGHES AND STERLING.

The "Sterling" refuse destructors are now in successful operation in many places, and among those recently put to work or now in course of erection are those at Barry, Aston Manor, Morecambe, Hackney, Bermondsey, Gravesend, and Frederiksborg. The engine room of the Hackney installation is illustrated on page 998, and the plant calls for some detailed notice, as it is said to be the most powerful yet put into use in conjunction with an electricity generating station, and moreover to be the lowest working cost of any metropolitan station under a local authority. The plant comprises the following: Twelve cells arranged in three groups, each group having a central supplementary combustion and dust depositing chamber; three large water-tube boilers, each of 2,852 square feet heating surface, working with the safety valves set at 200 lb. though the boilers are made suitable for 250 lb. pressure. Three powerful fans direct-driven by electric motors supply the necessary forced draught, through a system of air mains. Three electrically driven elevators discharge into storage bins, the capacity of the bins being about 200 tons. The bins supply by gravity the furnaces as required,

through the medium of shoots leading to the charging doors over the drying hearth. A large Green's economiser, and a complete range of flues and by-passes, enabling the gases from the furnaces to be directed through the boilers and economisers, either the economisers or boilers only, or direct to the chimney shaft without being utilised in either the boiler or economiser. The highest value obtained on the peak load is stated at 105·8 units per ton of refuse.

#### CONSOLIDATED PNEUMATIC TOOL COMPANY.

The productions of this company are now well known and many of them have already been described and illustrated in PAGE'S WEEKLY. Contractors who visited the Agricultural Hall were able to note the application of these pneumatic tools to the necessities of building construction, and they are stated to have been successfully used in connection with the building of the new Ritz Hotel in Piccadilly, the light weight of the rock drills, their rapid stroke, compactness and economy in air consumption being advantages which users have been quick to recognise. We illustrate the No. 1 "Little Giant" drill, fitted with patent split nut for boring in iron ore and coal. It is claimed that it will drill  $1\frac{1}{2}$  holes 3 ft. deep per minute in iron ore containing 35 per cent. to 50 per cent. of iron, the maximum depth of hole being 6 ft., this depth being obtained by using these drill bits of varying lengths.



FIG. 5. "LITTLE GIANT" DRILL FITTED WITH PATENT SPLIT NUT, FOR BORING IN IRON ORE AND COAL.





## Wire Ropes for Winding : Their Strength, and Some Causes of its Reduction.

BY MESSRS. J. A. VAUGHAN AND W. MARTIN EPTON.

THE ropes hereafter dealt with are those in use in the Transvaal, and the working conditions referred to are the local conditions that exist in either its gold or coal mines.

### FACTOR OF SAFETY.

The duration of the working life of a winding rope depends to a great extent on its suitability for the work it is called on to perform. A rope of a certain grade and construction, which is specially adapted for work in one particular winding proposition, may not be successful, in fact may be a failure, if put to work in another shaft. While the duties of different ropes employed under identically the same conditions are capable of comparison, the duty of one particular rope in comparison with that of another rope working under different conditions is a difficult matter to assess. In the former case, the depths of working and all other circumstances being the same, the simple formula  $\frac{\text{Total ore hoisted}}{\text{Cost of rope}}$  would apply, but in the general case it appears to the writers that the correct estimate would be more nearly approached by a formula such as  $\frac{\text{Mileage run}}{\text{Factor of safety}}$ , it being necessary, however, to consider the true effective strength of the rope in comparison with the total effect of all the destructive influences, and not merely the statical load, in estimating the real factor of safety of the rope. The cost of different classes of ropes to obtain the same factor of safety is very probably about the same.

Until the probable magnitude of the influences producing stress and deterioration in the rope can be calculated, so long shall we continue, as at the present day, to create, by means of an arbitrarily fixed multiplier, a barrier against accident, which, as we all know, does not in every case prove effective, and which, even while it may be safe, may not be economical. Further, when the provision of this

factor of safety appears lavished in its protection, it may for this very reason inspire a confidence leading to carelessness.

### TENSILE STRENGTH OF STEEL IN WINDING ROPES.

Steel, as it appears in our winding ropes to-day, is of far higher tensile strength than that used a few years ago, and while it is true that high tensile efficiency is obtained at the sacrifice of toughness and ductility, the extent of the sacrifice is not as great as many people suppose. This steel is manufactured from "blister or cemented steel" by the crucible process, with the addition of carbon and manganese. The percentage of carbon in the product varies in different qualities from 0.5 to about 0.8, and the percentage of manganese from 0.3 to 0.7. The percentage of silicon is kept as low as possible, say 0.15, while phosphorus and sulphur are only tolerated in the most minute quantities, their presence being fatal to the success of the drawing, annealing, tempering, and patenting processes that produce high grade wire.

The tensile strength met with in wire ropes on these fields at the present time varies from 90 tons\* to 160 tons per square inch, and the meaning of the trade terms describing the varying qualities is apparently as follows:—

"Improved Plough" from 130 tons per square inch upward.

"Best Plough" from 115 to 130 tons.

"Plough," from 100 to 115 tons.

"Improved Patent Crucible" about 95 tons.

"Best Patent Crucible," about 90 tons.

The following tables, taken from Hrabak's "Die Drahtseile," show how the flexibility of high-grade steel wire has increased in recent years owing to improvements in the methods of manufacture. The

\* All tons mentioned in this paper are "short" tons of 2,000 lb. each, except where otherwise stated.



length of wire subjected to the torsion test was 200 mm. (= 7.874 in.), and the radius of the 180 deg. bends in the bending test was 5 mm. (= .19685 in.).

#### EXPERIMENTS CARRIED OUT SEVERAL YEARS AGO.

Ultimate tensile stress of material. Tons of 2,000 lb.	12'67				85'34				106'67				128'01			
Diameter of Wires (in.)	55	078	098	055	078	098	055	078	098	055	078	098	055	078	098	055
Number of 180° bends	27	18	14	26	17	12	26	16	11	25	16	10	25	16	10	25
Number of rotations	60	52	40	26	21	18	26	20	17	23	19	16	23	19	16	23

#### EXPERIMENTS CARRIED OUT IN 1900.

Ultimate tensile stress of material. Tons of 2,000 lb.	106'67			
Diameter of Wires (inch)	0'43	0'47	0'55	0'63
Number of 180° bends	63	36	30	23
Number of rotations	50	42	40	34

Hrabak states that while in earlier times the modulus of elasticity of good iron wire amounted to about 16,000 kg. per mm.<sup>2</sup> (= 22,757,000 lb. per square inch), and while that for hard steel came high above 20,000 kg. per mm.<sup>2</sup> (= 28,446,000 lb. per square inch), the last amount has scarcely ever been reached with the modern hardest drawn steel wire used for winding ropes (128 tons per square inch).

#### TESTS IN THE MECHANICAL LABORATORY OF THE MINES DEPARTMENT.

Table I. shows the results obtained by the writers in the Mines Department Mechanical Laboratory in tests of wires of various sizes taken from new ropes. The ultimate tensile stress varied from 82.6 tons to 159.8 tons per square inch. The number of bendings (180 deg.) over  $\frac{1}{4}$  in. radius obtained varied from 4.9, in the case of a crucible steel wire of .128 in. diameter, to 50.7 in. in the case of a best plough wire of .051 in. diameter. To compare the number of bendings in different sized wires of different grade steels is a difficult matter. The great difficulty lies in the fact that the breaking stress of the material decreases as the number of applications increases, and also it has to be remembered that the stress produced even at the first bending exceeds the elastic limit of the steel, judging the latter by the tension test. The elasticity of the skin of the wire may, however, be different from that of the remainder of the section.

Regarding the test from any standpoint ultimate stress does not give a correct basis of comparison. The writers have taken the square root of the number of bends in a formula ultimate tensile stress of steel  $\times$  diameter bent over

$$\sqrt{\text{number of bendings} \times \text{diameter of wire}}$$

which should give, perhaps a number of proportional to  $E_0$ , the modulus of elasticity of the wire. Anyway, the approximation gives very interesting results Column 7 in Table I. shows this comparison.

In the torsion test, the number of rotations depends on the quality and size (diameter) of the wire under test. It has, however, also to be considered how evenly, or otherwise, the spiral lines produced by the rotations are spaced along the length of the wire. This effect bears witness to the homogeneity of the steel, and can be observed by the feel, or by the appearance, in the latter case either with or without magnification.

To compare the number of complete torsions obtained from wires of various sizes and grades, the writers have, for want of any better formula, used the following:—

$$\frac{\text{No. of complete turns} \times \text{diameter of wire} \times \text{ultimate tensile stress of steel}}{\text{length of test piece (inches)}}$$

the results being shown in column 9 of Table I.

With reference to the length of the specimen in torsion tests, which is generally 8 in., the writers made a few experiments with other lengths. The results they obtained seemed to show strangely enough that the length of 8 in. was especially favourable, for the torsions per inch length decreased, both in lengths shorter and in lengths greater. This refers to effects noticed in wires of from .081 in. to .128 in. diameter.

Winding ropes in the Transvaal are in nearly every case composed of six strands around a hemp core, and, with few exceptions, have the component wires of the strands twisted in the same direction as the strands are twisted in the rope, i.e., Lang's lay. The lay is practically always right handed.

#### HEMPEN CORES.

There exists a great variety of constructions of the strands of the rope, but in practically all cases the core is wire—generally a single wire. This construction Hrabak unequivocally condemns. He favours a hemp core in the strand; he styles the strand with the wire core a "stiff" strand, and rates it very high in the matter of bending stress, in fact, in the same grade as the hemp cord strands of a flat rope. Hrabak proves theoretically that the centre wires of cores carry  $62\frac{1}{2}$  per cent. of the full



TABLE I.

No. of Test.	Diameter of Wire.	QUALITY OF STEEL.		Mean Breaking Load in lbs.	No. of 180° Bends over 1/4 in. Radius.	Approximate Relational Efficiency under Bending.	No. of Torsions in Length of 8 ins.	Approximate Relational Efficiency under Torsion.
		Trade Name.	Ultimate Stress observed in Mechanical Laboratory.					
			Tons of 2,000 lbs.					
	in.							
104	·049	Improved patent	102·6	387	—	—	62·8	39·46
135	·051	Best plough	120·3	491·49	50·7	165·6	59·4	45·55
136	·051	do.	133·2	544·38	47·5	189·4	51·5	43·73
141	·057	Not quoted	124·5	635·48	20·5	241·2	59·5	52·78
149	·057	Improved plough	124·4	634·75	23·5	225·1	51·5	45·65
86	·060	Not quoted	97·4	551	20·5	179·3	50	36·52
84	·064	Patent	101·3	652	13·7	213·8	46	37·28
72	·072	Not quoted	117·3	955	13	225·9	54·2	57·22
42	·073	do.	132·0	1,105	13	250·8	29·9	36·01
92	·073	Special improved patent plough	135·8	1,137	12·5	263·1	34·1	42·26
113	·073	Not quoted	135·0	1,130	11·4	273·9	38·7	47·67
114	·073	do.	136·4	1,142	11·4	276·7	34	42·32
147	·073	Special improved patent plough	141·4	1,184	11	292·0	30	38·71
58	·075	Not quoted	132·2	1,168	11·2	263·4	34·6	42·88
74	·085	do.	82·6	937	7·86	173·3	38·6	33·88
60	·085	do.	132·3	1,502	11	234·7	28·4	39·92
104	·088	Improved patent	106·7	1,298	9·5	196·7	30	35·21
58	·090	Not quoted	139·2	1,771	7·86	275·9	21·8	34·14
84	·091	Patent	105·2	1,369	8	204·4	32	38·29
102	·092	do.	95·1	1,264	8·3	179·4	26	28·43
97	·093	Not quoted	114·4	1,553·8	8·5	211·0	23	30·59
139	·093	do.	131·5	1,787·07	8·7	239·7	33·2	50·75
10	·098	Best plough	115·0	1,735	10	185·5	35	49·31
11	·098	do.	115·5	1,742	9·8	188·2	28	39·62
13	·099	Not quoted	92·5	1,424	8·8	157·5	21	24·04
33	·099	do.	147·0	2,264	7·4	272·9	20	36·38
83	·099	Extra plough	159·8	2,460	6	329·5	16·7	33·02
160	·100	Not quoted	120·7	1,895·44	9·4	196·8	25·1	37·87
135	·101	Best plough	125·2	2,005·64	9	206·6	34·8	55·01
136	·101	do.	125·3	2,007·21	9	206·8	34	53·78
86	·102	Not quoted	124·8	2,039	7·6	221·9	28	44·55
141	·104	do.	134·1	2,278	7·2	240·3	29·2	50·90
72	·106	do.	131·6	2,323	6·7	239·8	29·9	52·14
134	·107	do.	118·4	2,129·6	6	225·9	26·3	41·65
9	·109	do.	98·5	1,838·35	5·2	198·1	26	34·89
149	·114	Improved plough	120·5	2,460·61	6·57	206·2	26·57	45·62
8	·122	Improved patent crucible	89·6	2,095·8	7·6	133·2	33·8*	41·05
12	·123	Plough.	106·9	2,540	6·5	170·5	21*	30·68
1	·128	Crucible	99·7	2,567	4·9	176·0	27·8	44·35

\* Torsions in length of 9 ins.



load so long as they do not break or remain immovable. He then goes on to show that the reason they do not break is that they remain gripped and in compression by the outer wires.

The only experience of the writers with hemp cores in strands of winding ropes was in the case of a flat rope. The strands in this case did not keep their shape well, and it may be anticipated that this advantage would also appear in the strands of a round rope, in which case the wires, by opening out, will allow the hemp core to get soaked with the mine water and thus tend towards deterioration by corrosion.

#### ARRANGEMENT OF WIRES.

The number of wires composing the strands of round ropes in general use here (1 in.,  $1\frac{1}{8}$  in. and a few  $1\frac{1}{4}$  in. diameter) varies from 7 to 22, made up in the following manner:—

6 round 1	Wires all the same size.
7 round 5 round 1	Wires differ in size, outside
8 " 3 " 1	circle composed of larger wires and often of a little higher grade material.
8 " 5 " 1	
8 " 6 " 1	
8 " 7 " 1	
9 " 6 " 1	All wires practically the same size, tending to have outside wires slightly larger, say, .003 in. difference.
10 " 5 " 1	
11 " 6 " 1	
12 " 6 " 1	
8 round a flat wire core of same grade as outer wires.	
9 round 3 twisted in opposite direction to outside wires.	
9 round 12 round a triangular core.	

#### NEED OF STANDARD SPECIFICATION.

The Mining Regulations prescribe that the breaking load (as certified by the manufacturer) of every new rope shall be entered in the Rope Record Book. For

these certificates to have any exact value, there should be, among rope manufacturers, absolute uniformity in the methods governing their assessments. Such uniformity certainly does not exist on these mining fields, and apparently in British colliery work the same difficulty is encountered. Mr. Futers, writing quite recently, states: Considering the importance of the work depending upon the winding rope, it seems a pity that some standardisation has not been adopted. Manufacturers issue lists, some fairly complete, others very far from complete, and the breaking strains are usually given under such terms as "plough steel," "patent steel," "mild steel," and "iron," but the quality of the steel—as "plough steel," for instance—of one maker may be of very much higher tensile strength than another; and again, some makers give the aggregate breaking strength of the wires, as the breaking strength of the rope; which is not the case, the latter varying from 10 to 30 per cent. less than the former. It would appear, then, that such terms as "plough steel," etc., should be made obsolete, and the rope listed as manufactured from steel, with a certain tensile strength of so many tons per square inch, depending upon the quality of the steel used, and the ultimate strength of the rope should be given, which will be somewhat less than the total ultimate strength of the wires.

The writers certainly favour a standard specification for winding rope—the tensile strength and ductility to be stated in some uniform and exact manner.

(To be continued.)

From a paper read before the Transvaal Institute of Mechanical Engineers.





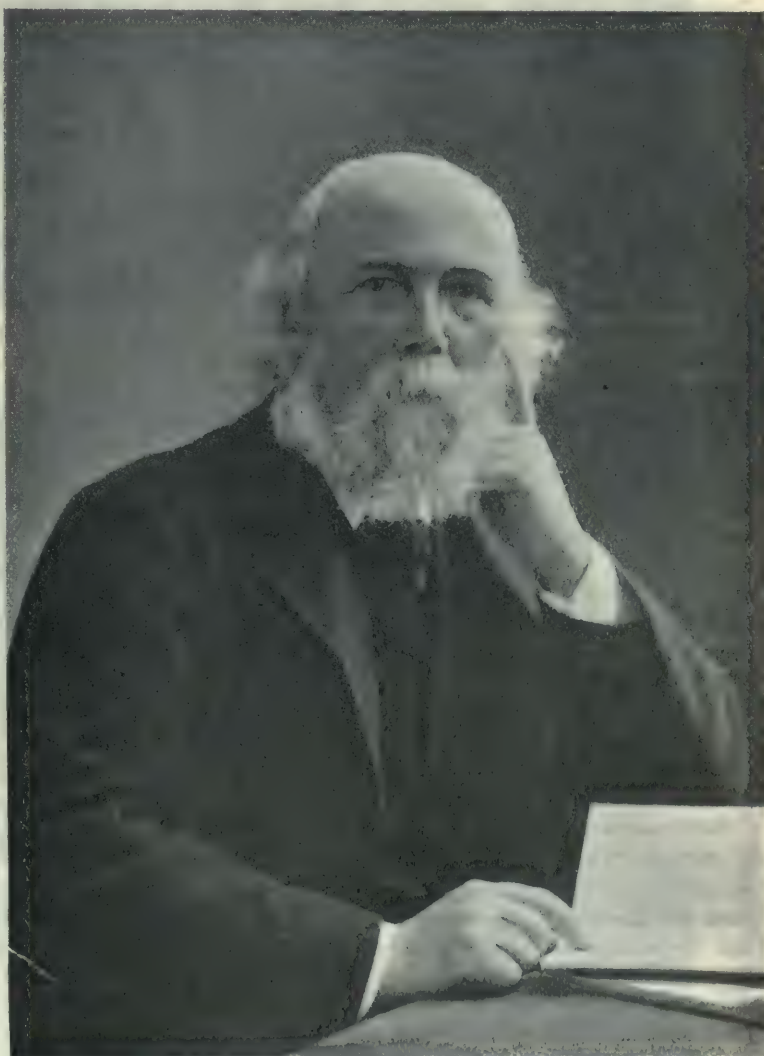
## OUR WEEKLY BIOGRAPHY.

## SIR WILLIAM THOMAS LEWIS, Bart., K.B., J.P., D.L., F.G.S.

THROUGHOUT the mining districts of South Wales there is, perhaps, no name held in more general esteem than that of Sir William Thomas Lewis. Born in 1837 at Merthyr Tydvil, he began to study engineering at the age of twelve, when he was apprenticed for five years to his father, who was one of the mechanical engineers of the Plymouth Ironworks. During this period he gained varied experience in the pattern shop, foundries, fitting shops, drawing office, and at the blast furnaces, as well as at the mills and collieries.

Upon the expiry of his apprenticeship in 1885 he was appointed junior engineer in the office of Mr. W. S. Clark, who was responsible for the construction of the first part of the East Dock at Cardiff. After four years' experience, which included the extension of the East Dock, the construction of the Rhymney Railway, with connections to the Taff Vale line, he was promoted to the position of resident engineer and chief assistant to Mr. Clark. He remained at the docks during the equipment of the extension and erection of the warehouses, until 1862, when he devoted himself entirely to colliery work, and was engaged in the exploitation of the minerals in the valleys of Aberdare and Rhondda. Owing to the steam coal being proved by Lord Bute's trustees in the Rhondda, a great impetus was given to the industry, and a number of properties were soon opened out, partly by levels in the upper measures in the northern portion of the

Rhondda Valley, and partly by pits at Tylacoch, Dunraven, and other places. Sir William took an active part in this work, and shortly afterwards he was associated with the opening of the Ferndale collieries, which were first operated for the purpose of working bituminous coal, but in



SIR WILLIAM THOMAS LEWIS, BART., K.B., J.P., D.L., F.G.S.



consequence of the No. 3 Rhondda not proving a workable section, were extended down to the steam coal measures. He was also engaged in the sinking of the Deep Duffryn pits, and in sinking the Navigation Collieries, which were then the deepest pits in South Wales.

In 1862 he was taken into partnership by his chief, upon whose death two years later he was appointed successor as head-mining engineer of the South Wales estates of the Marquis of Bute and Lord Dynevor. Later on he was offered an appointment which he accepted, as mining engineer to Lord Llanover's collieries. For some considerable time before the establishment of the Monmouthshire and South Wales Coalowners' Association, which was brought about by his intervention and by negotiations between the ironmasters and the coalowners, he had a standing retainer as the representative of the coalowners in the various wage disputes. He thus secured an intimate acquaintance with the whole of the varied customs and circumstances of the collieries working the different seams throughout that portion of the South Wales coalfield between Llanelly and Pontypool.

Sir William had charge of the great arbitration in 1871, and the skill he displayed in these matters induced the various colliery owners to have such confidence in his judgment that after much difficulty he was able to bring about an arrangement which resulted in the formation of the Monmouthshire and South Wales Coalowners' Association, embracing the employers in the iron and steel works, and the colliery owners. In 1875 he was instrumental in terminating a general strike and lock-out by the formation of a sliding scale committee, and he was again entrusted by the employers with the duty of formulating their case. After sittings that extended over six months, which involved Sir William's going into the costs and relative selling prices of the whole of the collieries in the district, the negotiations resulted in an agreement to the mutual satisfaction of the disputants. He continued on the Sliding Scale Committee until 1899, when he retired, having been chairman for eighteen years in succession.

In 1880—the year Sir William contested the Borough of Merthyr Tydvil—he abandoned his large practice as consulting engineer and arbitrator in order to undertake the general management of the Bute Docks, and the same owner's mineral properties in South Wales. There was an increasing demand for additional dock accommodation at Cardiff, and although Lord Bute had been repeatedly approached to provide the additional accommodation required, the financial results of his dock property had been so unsatisfactory, having regard to the large capital expended, that he

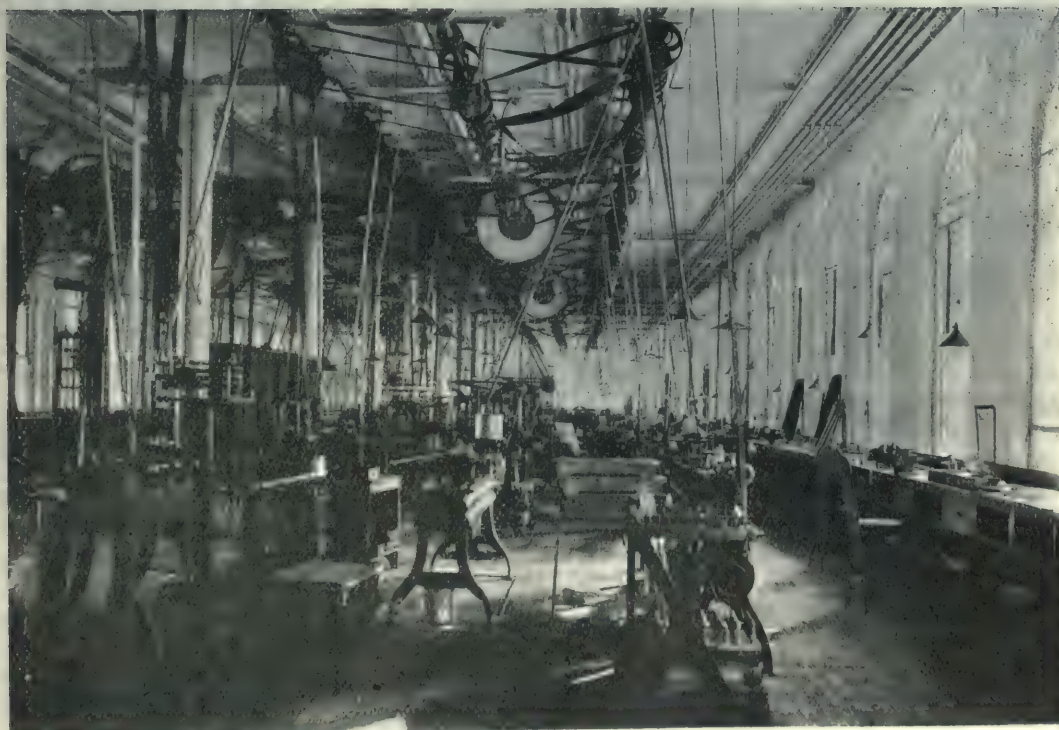
persistently declined to invest any more capital. Soon after his appointment, however, Sir William was able to show a great improvement in the returns, and to convince Lord Bute of the necessity to construct further docks. Application was therefore made to Parliament for powers to make the Roath Dock, which was subsequently constructed, and has been the means of accommodating a large class of vessels, and thus to preserve for Cardiff a very substantial portion of the coal trade of the district. About this time Sir William was responsible for a number of other developments to facilitate traffic, including improved railway arrangements, and additions to the number of shipping appliances, movable hoists and cranes, which increased the capacity of the Bute Docks by above 40 per cent. He was the first to appreciate the advantage of Taylor's movable hoist, which he had erected on the Roath Basin, and he also invented, in conjunction with the mechanical engineer at the dock, the patent system of shipping known as the "Lewis-Hunter" crane, which greatly facilitated the shipment of coal into large vessels in the Roath Dock.

Sir William served for seven years on the Royal Commission on Mines and also on the Commission on Mining Royalties, the Commission on the Effect of Coal-dust in Explosions, the Commission on Labour, and he is a member of the Commission on Coal Supplies, member of the Commission on Trade Disputes and Trade Combinations, and also a member of the Tonnage Committee of the Board of Trade as well as the Tariff Commission. He acted as a juror in two of the exhibitions in Paris. He is past-president of the Mining Association of Great Britain, past-president of the Institution of Mining Engineers, twice president of the South Wales Institute of Engineers, vice-president of the Iron and Steel Institute, member of the Council of Civil Engineers, vice-president of the Institution of Mechanical Engineers, and Deputy-Lieutenant of Glamorgan. For many years he has been chairman of the Board of Examination for mining certificates in the Cardiff district, and has also taken special interest in the establishment of hospitals. Chairman of many important companies, Sir William has secured a direct acquaintance with all matters appertaining to the iron, steel and coal industries by visiting and inspecting mines in America, Canada, and various parts of the Continent. In recognition of his public services in connection with the settlement of wages disputes, he received the honour of knighthood in 1885, and as a recognition of his many years' work as member of several Royal Commissions relating to mining and wages questions, in 1896 he was created a baronet.





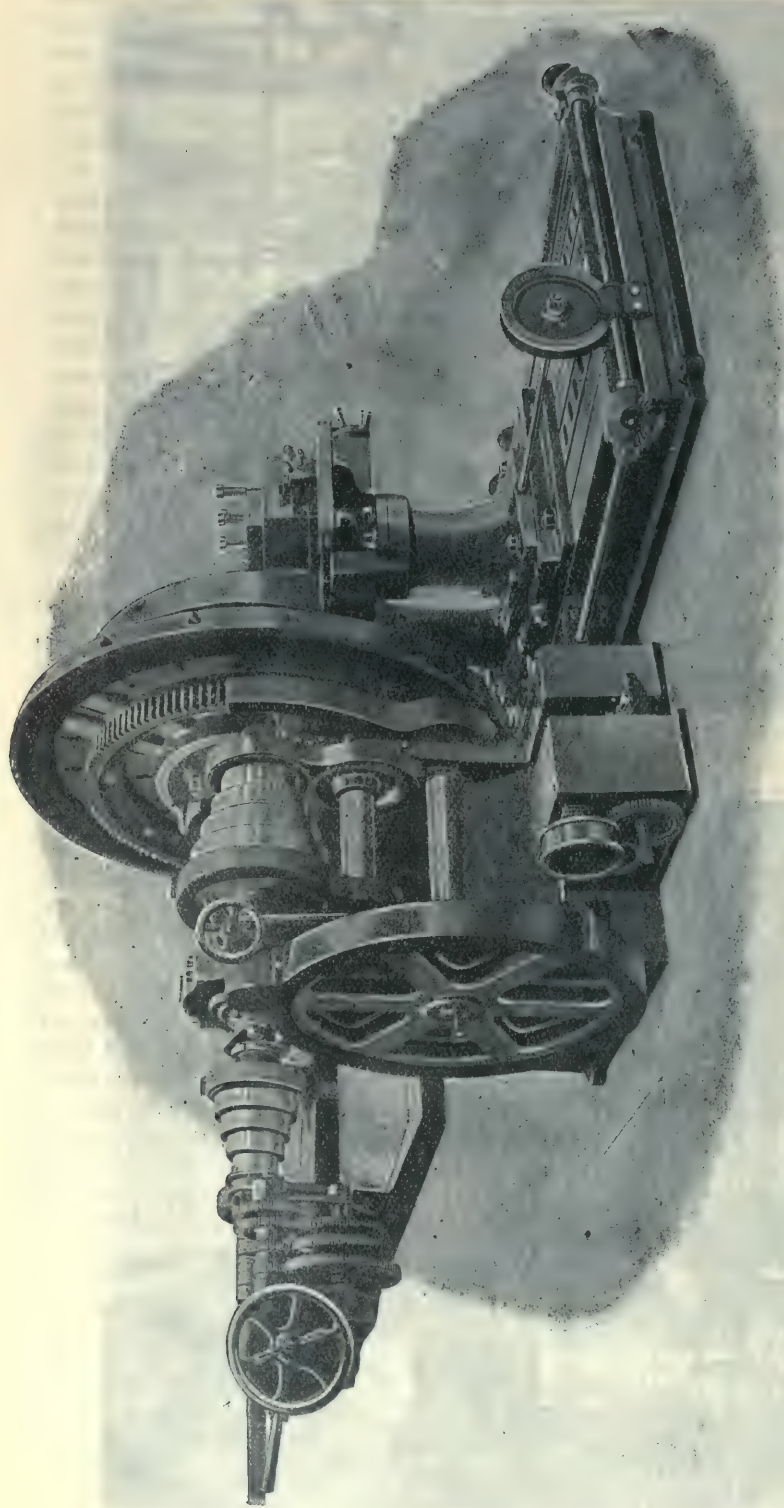
THE GUN-STOCK SHOP.



FIRST FLOOR—FINISHING SHOPS.

VIEWS IN SPRINGFIELD ARMOURY, SPRINGFIELD, MASS. (See page 1002.)





A FLY-WHEEL BORING, TURNING AND BOSSING MACHINE BY MESSRS. J. BUTLER AND CO., VICTORIA IRON WORKS, HALIFAX.

The machine herewith illustrated comprises an up-to-date turning lathe for general engineering work, with a special equipment for dealing with gas engine and other fly-wheels. It will finish a fly-wheel at one setting, turning the face, rims, inside and outside of boss and boring the holes—six tools being in operation at once.

The headstock and rests are mounted on a massive baseplate, making the lathe self-contained and ensuring perfect rigidity. The faceplate is securely bolted to the flange of the main spindle, which is a large cast-iron cylinder revolving in gun-metal bearings. A long cast-iron sleeve is held stationary inside this cylinder, and carries on the bed a facing arm for turning the inside of the boss. This is self-acting by screw feed. Inside the fixed sleeve

a boring bar revolves for boring out the hole of the fly-wheel. This boring bar is independent of the lathe in its motion, and is in fact, as will be seen from the illustration, a complete horizontal boring machine attached to the headstock and driven from a separate countershaft overhead, so that it may be kept running while the lathe is standing.

Six quick changes of continuous feed are given to the rests by gearing, each rest having a vertical shaft in the centre of the column worked by mitre gearing and splined shafts round the baseplate from a change feed box which has separate driving motion by pulleys on the countershaft. Reversing motion is also fitted on each rest, which serves also as a starting and stopping motion. The rests are made specially strong to bear high-speed cutting.



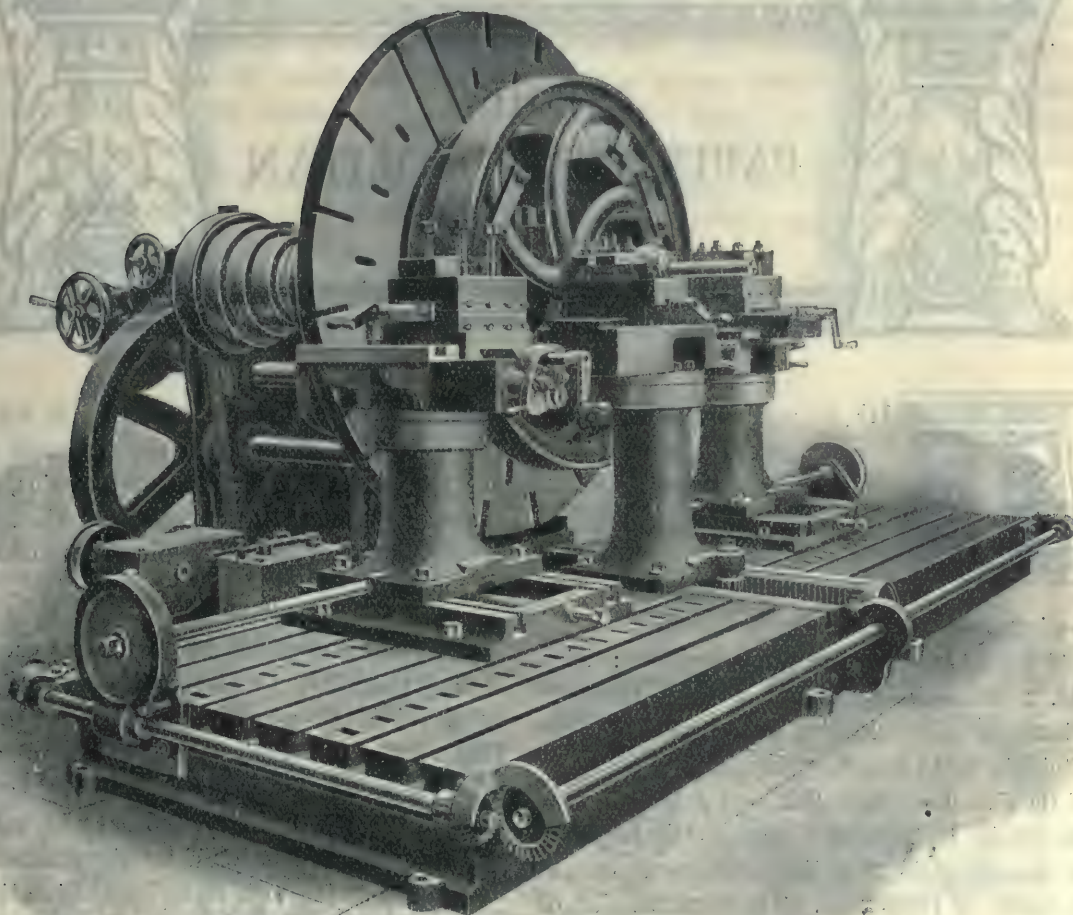


FIG 2. FLY-WHEEL BORING, TURNING AND BOSSING MACHINE.

#### THE INSTITUTION OF ENGINEERS AND SHIP-BUILDERS IN SCOTLAND.

The annual general meeting of the Institution of Engineers and Shipbuilders in Scotland was held recently at Glasgow, Mr. John Ward, vice-president, in the chair. It was announced that the only premium awarded for papers read before the association during the session "1903-4" had been gained by Mr. Johnstone, B.Sc., for a paper on "The Uses of the Integrator in Ship Calculations." The following officers were elected for the ensuing year: President, Mr. James Gilchrist; vice-presidents, Messrs. Andrew Laing and William Melville; council, Dr. Magnus M'Lean, Messrs. W. M. Alston, W. W. Lackie, Alex. Wilson, David M'Ghie, and J. B. Henderson.

#### THE MACHINERY TRADE OF CHEMNITZ.

A report by Mr. Vice-Consul Felkin, just received at the Foreign Office, states that generally speaking rather better conditions prevailed during 1904 in the machinery trade of Chemnitz and Saxony than in 1903, though they differed widely in various departments. Machine tools and locomotives seemed to give promise of a good demand at the commencement of the year, which, however, was not fulfilled; as regards the latter, this was due to the great care displayed by the Saxon railway authorities in placing orders. The large locomotive works have seriously considered the question of giving up building locomotives, but have so far come to no decision. A general review of German trade last year appears on page 1033.





THE Paris Metropolitan Railway system, a general plan of which is shown in fig. 1, was built by the City of Paris and is operated by a concessionary; the concession has thirty-five years to run.

The part now in operation includes: Line No. 1, all of it underground, from Porte de Vincennes to Porte Maillot, with a branch from the Etoile to Porte Dauphine forming the first part of the Circulaire Nord line, and a branch from the Etoile to Trocadéro forming the first part of the Circulaire Sud line; this was opened to traffic in July, 1900. The northern part of line No. 2, or Circulaire Nord, which is partly underground, partly on arches, goes from the Etoile to the Place de la Nation by the old outer boulevards; it was opened to traffic in April, 1903.

The length of line No. 1 is 6.40 miles, not including its branches, which are respectively 0.99 and 0.87 mile long; the length of line No. 2 is 6.65 miles, so that the total length is 14.91 miles. There are sixteen intermediate stations on the first line, one and two respectively on its branches, and twenty-one on the second. When the system is completed, its total length will amount to 46.6 miles.

All the lines are standard gauge double track lines, but the loading gauge is smaller than on ordinary railways; the distance between the

two tracks, centre to centre, is only 9 ft. 6  $\frac{3}{16}$  in. The steepest gradient is 40 per mile, and the sharpest curves have a radius of 3  $\frac{1}{4}$  chains, and exceptionally of 2  $\frac{1}{2}$  chains, except at the loops at the termini, where the radius is reduced to 1  $\frac{1}{2}$  chains.

#### CURRENT.

The trains are worked by continuous current at 550 to 600 volts, which is supplied to the motors by a third rail placed alongside the track. This current is obtained by transforming a three-phase 5,000-volt 25-cycle current, generated at three central power stations, by means of rotary converters at a certain number of sub-stations. One of these power stations, situated at Bercy, belongs to the Metropolitan Company; the two others belong to other companies with which the Metropolitan has made contracts for the supply of current; these are the Moulineaux station, which supplies also the electric line from Les Invalides to Versailles and sundry tramways, and Le Triphasé station at Asnières.

#### BERCY POWER STATION.

This power station, on the banks of the Seine, consists of a block of three buildings, the two end ones for the boilers and the central one for the machinery. The boiler-houses contain thirty semi-tubular boilers, having altogether 78,795 square feet of heating surface, working at 142.23 lb. per square inch, without superheaters, and twenty-four other boilers of the same type,



having altogether 64,586 square feet of heating surface and fitted with superheaters. The feed water, before reaching the boilers, passes through tubular heaters, which are heated by the exhaust from the donkeys and from a lift pump.

The fuel is brought in boats alongside the station; an electric crane raises it and tips it into a hopper, which feeds a system of transporters and elevators which pass it into bunkers parallel with the boilers after automatically

weighing it en route. Mechanical stoking is as yet only used on one set of boilers, as an experiment. The cinders fall into trucks which run in a gallery extending the whole length of the boiler house; at the end of the gallery there is a hoist to lift them. The feed water and steam pipes are arranged as ring mains, with valves allowing any damaged part to be cut out.

The engine-house, with two conduits running to the Seine, for feed water and condensing



Fig 1. — Plan of Paris Metropolitan Railway.

REFERENCE.

- |                                    |                       |
|------------------------------------|-----------------------|
| — Three-phase cables.              | — Lines authorized.   |
| — Lines in operation.              | — Lines proposed.     |
| — Lines in course of construction. | — Sections on arches. |

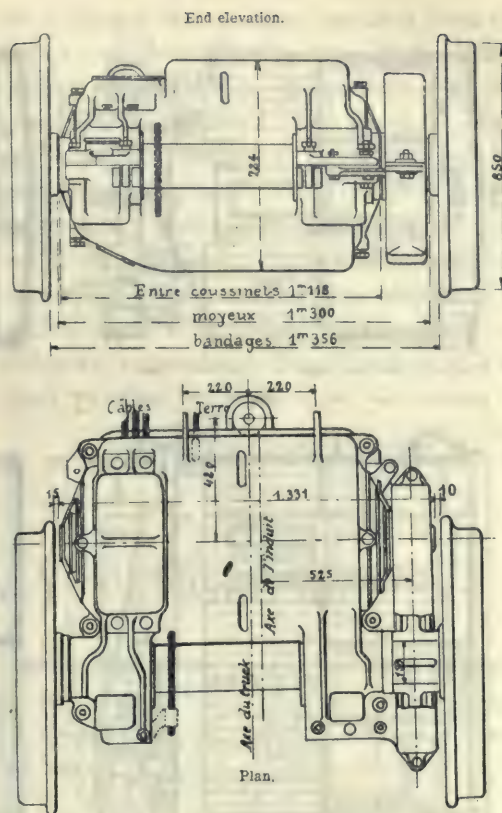






The lighting of the Circulaire Nord is supplied by a circuit which is quite independent of the traction circuit. Current at 600 volts from the storage battery is led to the points where the light is required, by means of fourfeeders, two positive and two negative, forming two separate circuits, one for the right side of the light and one for the left; the lamps are arranged in groups of five in series, the groups being connected in parallel across the mains.

The motor-cars (fig. 4) are fitted with two 140-h.p. motors, wound in series, each driving an axle by means of a simple reduction gear of 2·7 to 1 (fig. 5). The controller, which is arranged for series-parallel running, is of the ordinary type with magnetic blow-out. Most of the motor-cars have only one controller.



Explanation of French terms: Cables, Cables.—Entre coussinets=Between bearings.—Entre moyeux=Between hubs.—Entre bandages=Between tires.—Axe du truck=Centre of truck frame.—Axe de l'induit=Centre of armature.—Portée du coussinet=Length of journal.

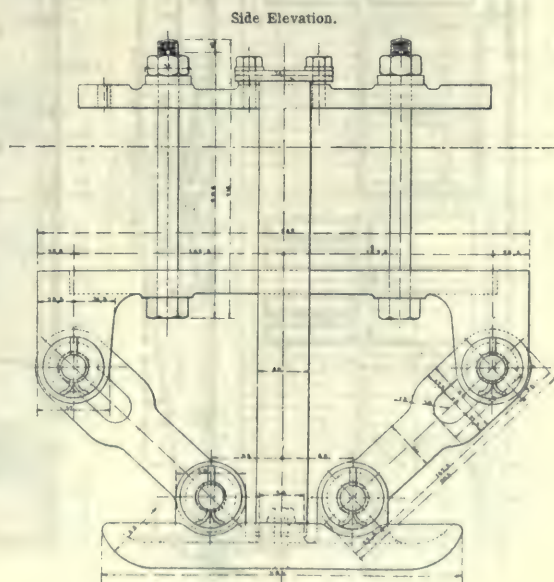


FIG. 6. CONTACT SHOE.



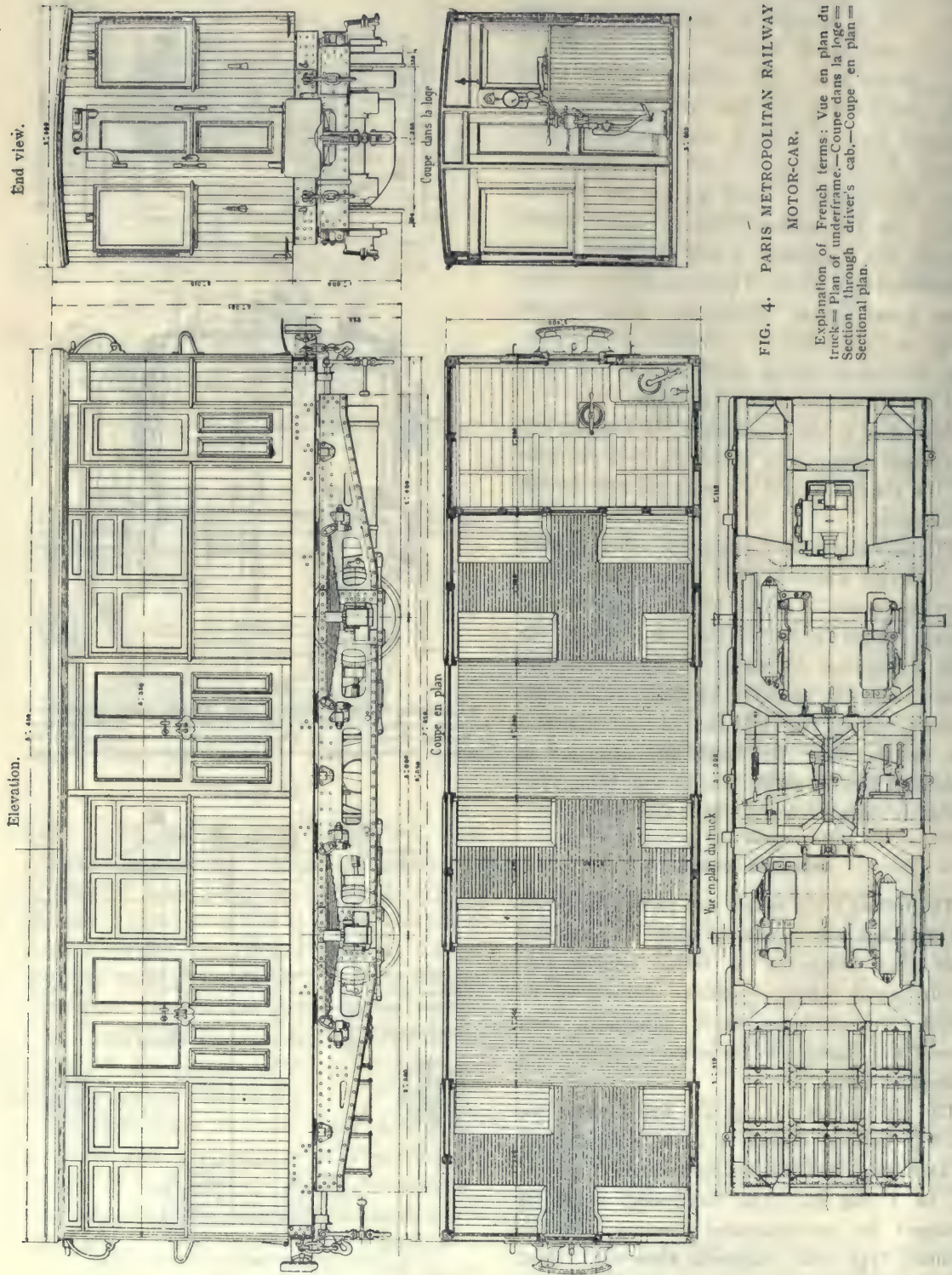


FIG. 4. PARIS METROPOLITAN RAILWAY MOTOR-CAR.

Explanation of French terms: Vue en plan du truck = Plan of underframe.—Coupe dans la loge = Section through driver's cab.—Coupe en plan = Sectional plan.



and one cab ; some of them, however, have two, one in front and one behind : these are used on the Trocadéro and Porte Dauphine branches. Four lateral contact shoes suspended by links (fig. 6) take the current from the third rail. Each cab contains the ordinary safety appliances : automatic circuit breaker, fuses, lightning arrester. The compressed air necessary for the breaks is produced by an automatically controlled electric compressor.

#### WORKING.

The lines open to traffic are worked by close circuits, by means of terminal loops ; there are

three independent circuits, insulated from each other : one from Vincennes to Porte Maillot, another from the Place de la Nation to Porte Dauphine, and a third from Etoile to Passy. The time-table provides trains starting from each terminus every four minutes between 9 a.m. and 3 p.m., every three minutes before 9 a.m. and between 3 p.m. and 8 p.m., and then every four, five or six minutes. The service starts at 5.30 a.m. and the last train leaves at 12.30 a.m. The inclusive speed is about 13 miles per hour.

From the Bulletin of the Railway Congress.

## BRITISH RAILWAY PROGRESS.

THE table reproduced herewith from the 1905 edition of the Railway Year Book shows at a glance the progress which has been made by the various railway companies, in their time records, and is an instructive commentary upon British railway practice. The publication in question, issued from the offices of the Railway Magazine, fully maintains its claim to be known as the Whitaker of the Railway Service. In addition to the usual features, this, the eighth issue, has some timely details of new steamship and road motor enterprise. The number of the historical sketches has been increased ; the total length in equivalent single line track of most of the railways is also given, both in a table and in connection with the details of each line. The capital, revenue, expenses, etc., of some of the joint railways are published for the first time. Diagrams are included, showing the colours of locomotives and coaching and goods vehicles of each company. A list of storekeepers is given, thus increasing the utility of the "Railway Year Book" to manufacturers and merchants having business relations with railways. The information relative to Indian, Colonial, and Foreign railways has been tabulated and standardised, and particulars of many additional companies inserted in these tables. The specially drawn maps have also been carefully revised, the new lines, etc., opened during the past year being shown, and two additional maps have been inserted.

A very useful feature of this publication is the Railway Officers' "Who's Who," and in many ways the volume is a valuable work of reference.

DISTANCES AND FASTEST TIMES FROM LONDON TO PRINCIPAL TOWNS, IN 1904.

TOWNS.	Distance.	Fastest Times.	Accelerations on 1903 times.	RAILWAY FROM LONDON.
Aberdeen ...	Miles. 523	H. M. 11 7	...	Great Northern.
" ...	539½	11 15	...	London and North-Western.
" ...	536½	11 50	...	Midland.
Birmingham ...	113	2 5	...	London and North-Western *
" ...	129½	2 17	3	Great Western.
" ...	138	3 5	...	Midland.
Bradford ...	192½	3 53	...	Great Northern.
" ...	208	4 36	...	Midland.
Bournemouth ...	107½	2 6	...	London and South-Western.
Brighton ...	51	1 0	...	London, Brighton, and South Coast.
Bristol ...	118½	2 0	...	Great Western.
Cardiff ...	146½	2 55	...	Great Western.
Dublin ...	354	8 55	...	London and North-Western.
Dundee ...	462½	9 13	...	Great Northern.
" ...	465½	9 58	...	Midland.
" ...	478	10 35	...	London and North-Western.
Edinburgh ...	398	7 45	...	Great Northern.
" ...	400	8 0	...	London and North-Western.
" ...	406½	8 20	...	Midland.
Exeter ...	171½	3 15	...	London and South-Western.
" ...	193½	3 25	5	Great Western.
Glasgow ...	401½	13 0	...	London and North-Western.
" ...	423½	13 50	...	Midland.
" ...	440½	9 16	...	Great Northern.
Hull ...	181	1 2	...	Great Northern.
Inverness ...	650	12 40	10	Great Northern.
" ...	558	12 50	...	London and North-Western.
Leeds ...	185½	3 35	...	Great Northern.
" ...	196	3 47	...	Midland.
Leicester ...	99	1 45	8	Midland.
" ...	103	1 45	5	Great Central.
Liverpool ...	199½	3 45	10	London and North-Western.
" ...	220½	4 20	15	Midland.
" ...	238	6 3	...	Great Northern.
Manchester ...	183½	3 30	15	London and North-Western.
" ...	190	3 35	10	Midland.
" ...	203	4 40	...	Great Northern.
" ...	206	3 50	45	Great Central.
Newcastle-on-Tyne ...	258½	5 12	...	Great Northern.
Norwich ...	114	2 32	...	Great Eastern.
Nottingham ...	128½	2 14	8	Midland.
" ...	126½	2 11	20	Great Central.
" ...	128½	2 40	...	Great Northern.
Perth ...	441	8 53	2	Great Northern.
" ...	450	8 55	5	London and North-Western.
" ...	451	9 35	...	Midland.
Plymouth ...	230	4 44	...	London and South-Western.
" ...	246½	4 27	17	Great Western.
Portsmouth ...	74	1 55	...	London and South-Western.
" ...	86½	2 1	...	London, Brighton, and South Coast.
Sheffield ...	182	3 25	...	Great Northern.
" ...	158½	3 0	20	Midland.
" ...	164½	2 57	3	Great Central.

\* Reduced to 2 hours from March 1st, 1905. † Central Station, not Euston Street, as last year.



## TECHNICAL SOCIETY NOTES.

**A**MONG the great technical societies, the Institution of Electrical Engineers is the youngest, and it still exhibits not a little of the exuberance of youth. At a date when other societies have got through their spring-cleaning and are engaged in hanging out the sun blinds, the Institution of Electrical Engineers is still keeping its members at the pursuit of knowledge. Last week the president and a large following put in an appearance at the Society of Arts to discuss the burning question of motor load development, raised by Mr. A. M. Taylor some time ago at the Birmingham Local Section.

The paper assumes that existing prices for power for small stations are prohibitive as far as the capturing of continuous loads is concerned, and that where they are not prohibitive they are unsound. Mr. Taylor's main point is in advocacy of the restricted hours system. Brighton and Montreal are quoted as examples of the successful operation of this plan of work, and a tempting picture is drawn of the delicious morsel, in the way of 500,000 horse-power going begging in London, and ready to fall into the lap of the lowest bidder. Nearly every speaker, however, disagreed with Mr. Taylor as to the possibilities of the restricted hours system. The feeling was that it must be continuous supply or nothing.

Mr. A. C. Eborall in a lengthy communication to the Institution on the subject of the alternating-current series motor tells us, that he does not think the problem of the single-phase motor for traction work can be considered as solved until such motors can be perfectly well-built for, and operated on, the standard frequency of 50 cycles, thus enabling single-phase railways if desired to be supplied with energy from power companies operating

in the districts through which they run. So far as compensated series motors for industrial purposes are concerned, he predicts that before long such motors will be commercially available, and that once having reached this stage, the evolution of a satisfactory 50-cycle railway motor is only a question of time.

It so happens that Mr. Ionides has just read a paper before the Glasgow Local Section on the very subject mentioned by Mr. Eborall, "Alternating-Current Motors in Industrial Service." He points out that the presence in almost every industrial centre of electrical power distribution companies, supplying power over distances, necessitates the use of alternating-currents, and that a good deal of attention is now being directed towards the alternating-current motor, with a view to accomplishing as good results in all classes of power driving as have until recently been considered practicable only by the use of direct-current motors

The great argument in favour of the alternating-current motor, particularly of the squirrel-cage type, is its simplicity and the absence of wearing parts. It is true it has not the advantage of shunt regulation for variable speed work that the direct-current shunt-wound machine has, but there are other ways in which different speeds may be obtained with equally high efficiency, and the importance of being able to vary the standard shunt-wound motor 10 or 15 per cent. is probably somewhat over-rated. The squirrel-cage type is cited as being particularly well adapted for driving spinning machinery for mining work, for driving high lift turbine pumps, but for the driving of large haulages which must be started slowly and gradually the slip-ring motor is preferable.



## German Iron and Steel and Machine Tools in 1904.

THE economic recovery which characterised the last months of 1902 and the whole of 1903 continued steadily in the first half of 1904, but in the second half a gradual falling-off became apparent, and in the coal mining and iron industries the situation at the end of the year was less favourable than six months or even a year before. The return of a period of real prosperity such as prevailed from 1896 till 1900 seemed more remote at the end of 1904 than nine months earlier; nevertheless, on the whole, the year under review showed an improvement as compared with the preceding year. Trade and industry, with the exception of the coal mining and iron industries, were more active, the labour market satisfactory, and the number of unemployed comparatively small.

The report on the trade of Germany for the year 1904, by Mr. Consul-General Schwabach, from which this statement is taken, proceeds to chronicle the fact that the iron and, more particularly, the pig-iron industry, and, in a measure, also the coke and coal industries, which are to a large extent dependent on the pig-iron industry, were decidedly disappointing. It is to be remarked that the condition of the German pig iron industry is at present largely a question of exports. The requirements of the home market represent a factor that cannot be changed or influenced at will to any appreciable extent. The inland demand is slowly increasing after the collapse in 1901, but it has not approached the record of 1900. The considerably reduced home consumption placed the pig-iron works in 1901 and the following two years before the alternative of either reducing their output by a third or even more, or forcing the exports by sacrificing profits; they chose the latter course, with what results has been stated in previous reports. The exports of iron and manufactures of iron, which rose from 1,509,887 tons in 1899 to 2,347,211 tons in 1901, 3,309,007 tons in 1902 and 3,481,224 tons in 1903, were largely effected at prices which left very small or no profits at all to the works, the benefit falling chiefly to the workmen who could be kept employed and whose wages could be maintained; but these forced exports had the serious drawback of raising the cry against German "dumping" in the United Kingdom and elsewhere.

With the collapse of the American market an important outlet was not only closed but German exporters encountered American competition in other markets,

especially in the British and Belgian, and, moreover, the newly formed German Steel Works Syndicate decided in April, 1904, to discontinue the practice of "dumping," much to the prejudice of those iron works (especially in Lorraine and Luxemburg) that relied on the export business for a very large part of their production. The great expansion of the German iron works necessitated either an enormous increase in the inland demand—which did not take place in the last four years—or an extension of the export trade if the works were to be fully or even moderately employed. With but a slowly increasing inland demand and a greatly reduced export trade the record production of 10,086,000 metric tons of pig iron in 1903 was only just maintained in 1904, and the increase in the output of coke, and also, to a corresponding degree, of coal, was smaller than in the two preceding years. The regions affected by these adverse conditions were principally Rhenish-Prussia and Westphalia, where the unsatisfactory state of the coal mining and iron industries became more pronounced in the second half of the year and reacted unfavourably on the general condition of these provinces.

Other industries present more cheerful aspects, and while the year 1904 cannot be designated an exceptionally "good" one, it may yet be assumed that the condition of German trade and industry in the last two years, *i.e.*, 1903 and 1904, was, perhaps, better on the whole than that of any other European country.

The increased imports of coal have benefited chiefly the United Kingdom, which exported to Germany 5,808,000 tons as against 5,394,000 tons in 1903.

Exports of machine tools from Germany during the years 1904-1900 have been as follows:—

To—	Quantity.				
	1904.	1903.	1902.	1901.	1900.
	Met. tons.	Met. tons.	Met. tons.	Met. tons.	Met. tons.
United Kingdom ..	1,470	2,073	1,604	336	250
Belgium ..	1,336	1,421	2,408	466	344
Netherlands ..	1,087	1,063	1,007	321	228
France ..	2,452	2,506	3,142	1,166	1,200
Italy ..	2,205	1,615	1,262	793	976
Austria-Hungary ..	3,675	2,892	2,426	1,270	1,236
Roumania ..	490	192	212	25	..
Russia ..	3,579	3,218	3,246	1,746	2,370
Sweden ..	1,044	702	717	389	385
Switzerland ..	1,978	1,327	995	538	964
Spain ..	1,377	687	953	161	102
China ..	506	318	207	23	41
Dutch East Indies ..	..	192	217	71	..
Argentine Republic	364	215	129	134	39



# FRICITION AS AFFECTED BY LUBRICATION.

By WM. PARISH, JUNR.

THE earliest forms of machinery devised by man were so poorly designed that nearly all the power to operate them was lost by the friction of the machine itself, no matter what lubricant was used. With these slow-running, ponderous machines any form of grease was good enough. With the gradual development of all classes of machinery, lubrication was given its proper place. At first only the fixed oils, comprising the animal and vegetable oils, were available, but these were gradually superseded, as the advance in scientific knowledge enabled the producer to manufacture suitable petroleum lubricants at a much lower cost, which contained none of the drawbacks of the fixed oils.

The comparative frictional reducing qualities of lubricating oils are shown in the physical laboratory by means of frictional testing machines. These are of many kinds, but they all embody the same general idea, and consist of a spindle or shaft of known diameter turning in a carefully adjusted bearing upon which is put a known weight or tension. The art of economic lubrication was undoubtedly started as a result of the scientific study of tests made upon these instruments. The great practical effect from the use of these machines is that the manufacturer of lubricating oils has been much enlightened and guided in producing methods of manufacture that have resulted in retaining a greater percentage of the natural lubricating power of the crude material worked with. The limitations of the testing machines were early appreciated by the oil manufacturer, and by the chief operators.

It can positively be stated that the conditions surrounding a friction testing machine are never duplicated in a mill or shop. The instrument bearing is carefully ground to a surface, and is of the most exact diameter. The bearing is as nearly perfect as it can be made; in many cases it is water cooled. The speed of the instrument and the method of applying the lubricant, and all the conditions surrounding the instrument, are quite the opposite to the conditions surrounding the bearing on which the lubricant is finally intended to be used.

Owing to the limitations placed upon these instruments an effort was made to work out some practical method of showing the comparative value of lubricants under actual working conditions. This took the form of testing small machines, and especially spinning frames, by means of dynamometers—small instru-

ments designed to register or indicate the amount of foot pounds required to operate a given machine. There are many forms of these machines, registering the force transmitted through them by means of a diaphragm transmitting a liquid pressure to a gauge, or by the lifting force of levers arranged to transmit the belt pull to an indicator, or by friction clutches transmitting the force to an ordinary beam scale, as in the pony brake.

## COMPARATIVE EFFICIENCY OF OILS.

In operating on a large scale to show the comparative efficiency of lubricating oils, it is necessary to select some particular class of manufacturing plant that presents the least difficulties to the investigator. There is no plant that has such a large friction work load (useful and lost) as a cotton mill. The power to drive the machinery, exclusive of the work of handling and manufacturing the cotton, amounts to practically 85 per cent. of the total, and while the variables to contend with are many the frictional surface is large and presents very great possibilities.

The laws which govern the science of lubrication are applicable to every branch of business, and to every class of plant, though it is sometimes impossible to show conclusively by instruments results as satisfactory as those that can be secured from the textile mills.

I will now describe in detail a full efficiency test of a textile mill where an effort is being made to reduce the total horse-power by means of applying lubricants more suited to the work than the oils in use. The first portion of the test is for the purpose of securing with the oils in use an exact total load upon the mill under actual working conditions. Indicators are applied to each end of each cylinder of the main engine of the plant. These indicators are fitted with electro-magnets, and are connected in series so that by pressing an electric button or throwing in a switch the circuit is closed, and all the instruments are put into use taking the diagrams simultaneously, and showing the exact amount of work being done at that moment by the engine.

Schedules are arranged to give readings for at least forty intervals a day, the intervals being placed according to the kind of plant operated upon. Sub-divisional schedules calling for loads of different departments usually bring the total number of indicator cards used to between 300 and 1,500 per day.



During the time the horse-power readings are being taken a complete record of speeds, temperatures, humidity and working conditions is being tabulated, the extent to which this is necessary being determined by the character of the plant tested upon. From two to five days are required before sufficient data is obtained to give an absolute average of all the working conditions of a plant. This working average is the basis of comparison, and is the actual point from which the mill load is reduced. The average represents the actual horse-power required to operate the working percentages of machinery driven by the engines tested upon under every practical condition of operation. Owing to the arrangement of the schedules all variables are averaged, and all other conditions and influencing factors noted and the proper value given.

After securing this working basis the oils tested upon are gradually displaced, and lubricants previously determined upon are introduced through the regular routine oiling up of the machines, no cleaning or changing of adjustments taking place. After a period of use—determined by the character of the previous oils and class of work tested upon—an exact duplicate test is made, using the same men, the same instruments on the same stations, and working to duplicate schedules. A comparison of the results shows exactly what commercial value is to be placed upon the change of lubricants. This is an elaborate growth of the laboratory tests upon a scientific machine, and makes the entire mill the machine tested upon.

I may give particulars of a total mill load of test made at Bridge Mill, Nelson. Charts were taken showing a reduction of 15 per cent. of the power required for shafting by changing from a well-known grease to oil, and showing a reduction of 9.2 per cent. on the total load of the engine, shafting, looms, and other machines. In another instance the test showed a reduction of 39.2 per cent. of power in favour of oil as compared with grease.

The ball-bearing theory of lubrication may be here referred to. The first film is supposed to travel at the surface, speed of the spindle (9,000 revolutions per minute), the second film at a less speed, as the outside film is dragging along the wall of the bolster, which is fixed. All of the films work upon each other at different speeds. When the oil is constructed so that the globule of the crude is retained in its natural state, the effect of the turning or working of the oil approximates to that of a ball-bearing journal, and the fluid or internal friction is at a minimum.

Abstract of paper read before the Tramways and Light Railways Association on April 28th.

## THE PIG IRON MARKET.

THE position of the pig-iron warrant market suggests that sensational developments are about to take place. At the time of writing as high as 54s. is being paid for cash Cleveland warrants, and the critical moment in the gamble is clearly at hand. A consideration of the position would lead to the belief that notwithstanding the manner in which the bulls have forced up the price of Cleveland warrants, the bear position stands on a sounder basis. Several things may be cited in support of this view, chief among which are the enormous production of pig-iron in the United States, the absence of the expected exports from this side, and the growing amount of stocks in the Middlesbrough warrant stores. These have now reached the huge total of 404,570 tons, double what it was in December, and by far the largest on record, and are an important factor of the situation.

The bulls pin their faith to the growing American consumption and apparently ignore a production which is believed to be greater than the country can absorb, and their resolve to call up all the iron and take it off the market is a desperate measure which may or may not be crowned with success. Those best qualified to judge are of opinion that the chances are against the success of these heroic tactics. It may be pointed out that the bears are receiving some support from the action of Cleveland smelters, who are naturally allowing their iron to go into store in order that they may secure the warrant price. In this proceeding they are willingly or unwillingly assisting the operations of the bears, and it is this movement which the bulls propose to put an end to by taking iron off the market. Naturally, the market has not been left entirely to the bulls and bears, as a good many genuine holders of warrants have been tempted by the high prices to realise. The point to note is that all the No. 3 iron is going into store, and that business in it is, therefore, practically suspended. Fortunately, hematite iron has been unaffected, so that the steel trade has not particularly suffered, and Scotch smelters have benefited to a certain extent from the tying up of Cleveland iron. How soon the break will come it is impossible to predict, but those makers who are willing to sell for future delivery at round about 48s., are probably doing the right thing, as a heavy fall in quotations is bound to occur when the market is presently flooded with the 400,000 tons of iron which has gone into store. From a purely trading point of view, the whole position is entirely unsatisfactory.



## Stand-By Charges; and Motor Load Development.

THIS paper, read before the Birmingham Local section of the Institution of Electrical Engineers, and discussed at the meeting held in London last week, starts with the assumption that existing prices for power from small stations are prohibitive, as far as the capturing of continuous loads is concerned; and that where they are not prohibitive they are unsound, except in a few favoured towns where the motor load does not class with the lighting load. Analysis is made of the charges to be levied per unit for two classes of motor, representing extremes in load factor, viz. Class I., having a 30 per cent. load factor, and Class II., a 7½ per cent. load factor, see table below.

The investigation is first made into charges for what are called "interest-paying" motors, *i.e.*, motors which are charged a sum to cover interest and sinking fund on new generating plant and mains rendered necessary by the overlapping of the lighting and motor loads.

A suggestion is then made to sell power at extremely low rates on the basis of the current being cut off during

"peak" hours. The generating plant having thus been protected, so far as the regular evening peak is concerned, the question arises as to how far a day fog may endanger the lighting supply from the station.

A case of quite phenomenal motor load development is worked out in detail, and the results show, the author thinks conclusively, that in any provincial town it would be perfectly safe to offer the suggested low rates without any danger of a day fog causing the lighting to be shut down; and even in London the system could be worked at the same rates if due precautions were taken to protect the lighting. Means are also indicated in the paper for further extending the load which might be taken up, should the development be exceptionally rapid. Stand-by charges are next considered, and possible improvement in the works cost, due to the elimination of these, is worked out. Results so obtained are then combined with the other reduced charges consequent on supplying the additional units on the "restricted-hour" system.

SUMMARY OF RESULTS: ACTUAL AND POSSIBLE SELLING PRICES OF ELECTRICAL ENERGY FOR A 5-H.P. MOTOR.

	Electric lighting only. Average of several stations of 2,000 kw. and under. 15% load factor.	Motors of Class I.			Motors of Class II.			Motors of Class I. Interest-paying rates. Station L.F.=60%. D.F.=1. Max. load = 2,000 kw. Equal night and day load.	Motors of Class II. Interest-paying rates. Station L.F.=22%. D.F.=1.5. Max. load = 2,000 kw. Equal night and day load.	Motors of Class I. only. Station L.F.=30%. D.F.=1. Max. load = 10,000 kw. No night load assumed.
		Station L.F.=30%. D.F.=1. Max. load = 2,000 kw. No night load assumed.	Ditto on "restricted hours" system. Station L.F.=46%. (37% motor load. 15% lights' load.) Small night load as per Fig. 1.	Ditto on "restricted hours" system. Station L.F.=64%. (58% motor load. 15% lights' load.) Large night load = day load.	Station L.F.=11%. (7½% × 1.5). D.F.=1.5. Max. load = 2,000 kw. No night load assumed.	Ditto on "restricted hours" system. Station L.F.=26½%. (13½% motor load. 15% lights' load.) Small night load as per Fig. 1.	Ditto on "restricted hours" system. Station L.F.=33½%. (21% motor load. 15% lights' load.) Large night load = day load.			
A.	1.20d.	.70d.	.45d.*	.40d.	.95d.	.50d.†	.45d.	.60d.	.85d.	.60d.
B.	1.00d.	.45d.	Nil.	Nil.	1.21d.	Nil	Nil	.22d.	.60d.	.32d.
C.	.23d.	.079d.	.018d.	.011d.	.242d.	.090d.	.055d.	.039d.	.121d.	.039d.
	(.115 + .115)	(.022 + .057)	(.022 × $\frac{30}{37}$ )	(.022 × $\frac{30}{58}$ )	(.104 + .138)	(.104 × $\frac{11}{13\frac{1}{2}}$ )	(.104 × $\frac{11}{21}$ )	(.011 + .028)	(.052 + .069)	(.022 + .017)
D.	.14d.	.040d.	.008d.	.005d.	.073d.	.011d.	.007d.	.020d.	.036d.	.033d.
	(.12 + .02)	(.030 + .01)	(.01 × $\frac{30}{37}$ )	(.01 × $\frac{30}{58}$ )	(.060 + .013)	(.013 × $\frac{11}{13\frac{1}{2}}$ )	(.013 × $\frac{11}{21}$ )	(.015 + .005)	(.030 + .006)	(.025 + .008)
E.	.37d.	.18d.	.06d.	.038d.	.44d.	.165d.	.105d.	.09d.	.22d.	.14d.
				(.06 × $\frac{37}{58}$ )		(.06 × $\frac{37}{13\frac{1}{2}}$ )	(.06 × $\frac{37}{21}$ )			
F.	2.94d.	1.45d.	.54d.	.45d.	2.91d.	.77d.	.62d.	.97d.	1.83d.	.93d.

A.—Works cost.

B.—Interest and sinking fund at 7 per cent. on "productive" capital only.

C.—Maintenance, salaries, and office expenses.

D.—Rates, taxes, etc.

E.—Net profit.

F.—Selling price.

\* Reduced from .70d. by subtracting "stand-by" losses.

† Reduced from .95d. by subtracting "stand-by" losses.



**RESTRICTED-HOURS SYSTEM.**

The "Restricted-hours" system has the advantage over a two-rate metre system, that a much lower price can be offered, because with the former no material expense whatever, either in plant or mains, has to be incurred; whereas with the latter it would seem that an extra charge must be levied on all units, and not only those which are inside the limits of the peak; otherwise the charges on the latter would probably bring them above even lighting charges.

In Montreal, where consumers of Class I. are charged respectively 1.24d. and 1.60d. per h.p. per hour for "restricted-hours" and "unlimited-hours" supply, some 30 per cent. of the h.p. connected is voluntarily taken up on the former basis out of a total of 11,000 h.p. connected to the mains. If only half this proportion were to hold for the 500,000 h.p., which, we are told, is going to the lowest bidder in London, there would be 75,000 h.p. in London which could be obtained on the "restricted-hours" system at the present time without a penny being spent in generating plant. Taking account of the fact that they are essentially manufacturing towns, it is probably safe to say that in, let us say, Birmingham, there must be quite 15,000 h.p., and in Sheffield 12,000 h.p. similarly obtainable, and in other towns in proportion. Will anyone maintain that this load is so insignificant as to be not worth the catering for? And would it not bring in its train quite a large proportion of "interest-paying" motors?

A suggestion is made for tiding over the peak load by a special arrangement of accumulator cells on consumers' premises.

The author has ascertained that responsible accumulator-makers would be prepared to maintain cells, under the conditions stated, at not more than 10-15 per cent. of the capital cost per annum.

On this basis a municipal electric lighting station could offer power at charges which would be of the order of only 50 per cent. of their present rates. The author suggests that the "restricted-hours" system at  $\frac{1}{2}$ d. to  $\frac{3}{4}$ d. per unit, supplemented by the private battery systems at  $\frac{1}{2}$ d. per unit additional, will be found to provide a means for obtaining a class of load hitherto out of reach. The system might also be used to "prospect" for battery sub-stations.

The author's conclusions are that in the case of lighting stations of 2,000 kw. and under, it is not safe to offer current for motor supply, for day use, at anything below 1d. per unit except under the restrictions indicated, or where the lighting and motor loads do not clash. Stand-by losses can be turned to account by reducing that part of the works cost which is chargeable to coal by some 30 per cent. in the case of supply for motors.

Abstract of paper by Mr. A. M. Taylor.

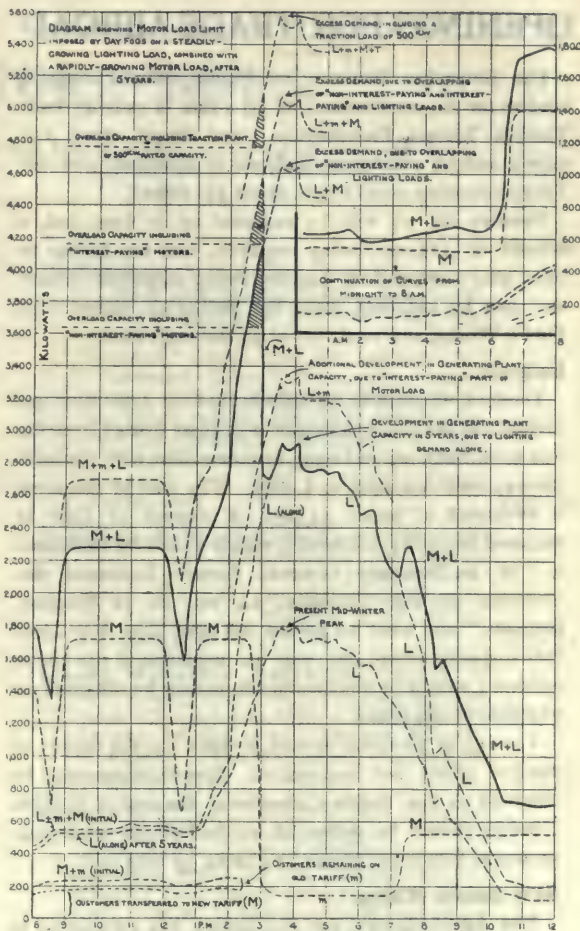


Diagram showing the growth of load due to development of lighting and motor business combined.

**OBITUARY.**

The death is announced of Mr. Stephen William Silver, whose name is inseparably connected with the "Silvertown" company (the India-rubber, Gutta-percha and Telegraph Works Company, Ltd.).

Mr. Thomas Matthews, probably the oldest railway official in the world, died on Tuesday, in his 87th year. He was one of the pioneers of the North London Railway, the erection of the stations on that line having been under his supervision. For the long period of fifty-seven years he was engineer of that railway.

**AN AMALGAMATION.**

We are advised that an amalgamation has taken place between the Vauxhall Ironworks Company, Ltd., and the West Hydraulic Engineering Company. The firm will be known as "The Vauxhall and West Hydraulic Engineering Company, Ltd."



## OPENINGS FOR TRADE ABROAD

The Bulgarian Ministry of Public Works require tenders for the construction of (1) a line of railway from Tirnova - Trevna - Barouchitzza (total length about 230 miles), and (2) a line from Radomir to Kustendil and the Turkish frontier (total length about 340 miles).

Tenders for (1) will be received up to June 2nd, a deposit of £28,000 being required, and for (2) up to June 9th, a deposit of £24,000 being required. Plans, etc., can be obtained from the Bulgarian Ministry of Public Works, at a total cost of £5 for each line.

### Belgium.

Tenders, which will be adjudicated on 24th May, are invited for the construction of a railway bridge over the line from Antwerp to Douai, in connection with the local railway from Antwerp to Lierre. The cost of the work is estimated at about £4,383. A deposit of £440 is required to qualify any tender, which should be addressed to "M. le Directeur General, Societe Nationale des Chemins de Fer Vicinaux, 14, rue de la Science, Brussels," and must be posted not later than May 23rd. Plans, specifications, etc., may be inspected at the above address; a copy of the specifications may be obtained on payment of one franc.

The city of Brussels invites tenders for the supply of electric cables and accessories. Specifications may be obtained 11, rue Sainte-Catherine at the cost of fr. 1.50. Tenders should be delivered at the College des Bourgmestres et Echevins, before 11 o'clock on 16th inst.

### New South Wales.

The Agent-General for this colony has forwarded to the commercial intelligence department of the Board of Trade particulars of contract for the supply and delivery of steel and iron, including the whole of the pig-iron and rolled steel and iron required by the Government of New South Wales, for a period of seven years.

The contractor is to establish within the State blast furnace or furnaces, and erect all machinery and plant necessary for the conversion of iron ore into pig iron, and rolled steel and iron, and capable of supplying all the materials included in the contract.

Tenderers must state the rates per ton at which they are prepared to manufacture, supply and deliver the material required. Practically the whole of the ore used must be raised within the Commonwealth. Tenders will be received at the office of the Secretary for Public Works, Sydney, New South Wales, up to 2 p.m. on Friday, 1st September, 1905.

The full conditions of contract, specification, and schedule of sizes of iron and steel materials required, together with notes on the iron-ore, coal, and limestone deposits of the State, may be seen at the above mentioned branch of the Board of Trade. Further details will be found on reference to PAGE'S WEEKLY of April 28th.

## NEWS ITEMS.

Messrs. Richards and Hopkins, Ltd., engineers and ironfounders, Caerleon, have decided to carry out extensions at their foundry, which will mean the employment of a larger number of men.

Messrs. Spurr, Inman and Co., Ltd., of Wakefield, announce that they have appointed Messrs. Umney and Peckett, of 46, King William-street, E.C., as agents for London and district for the sale of their boilers.

The Burma Gold Dredging Company, Ltd., have instructed Messrs. Lobnitz and Co., Ltd., Renfrew, to proceed with the building of another gold dredger to the designs of Messrs. Cutten Bros., and similar to the dredger supplied by the same builders last year.

The Corporation of Stockton-on-Tees have just decided to place with the Horsfall Destructor Company, Ltd., of Leeds, an order for the extension of their destructor. We are informed that the existing plant, which was erected by the Horsfall Company in 1901, has given results averaging 10 per cent. better throughout than their original guarantees.

We are informed that the Reid Gear Company, engineers and gearing specialists, of Linwood, near Paisley, contemplate doubling their plant this year, in order to cope with the constantly increasing demand for their specialities. Prominent among these is their worm reducing gear in C.I. case, forming oil bath, with double ball-bearing thrust.

The annual dinner of the Institution of Mining and Metallurgy was held on Wednesday evening at the Hotel Cecil. A report of the proceedings will appear in the next issue of PAGE'S WEEKLY. Among those who accepted invitations were: The Marquess of Londonderry, K.G., Lord President of the Council and President of the Board of Education; the Lord Harris, G.C.S.I., G.C.I.E.; the Right Hon. R. B. Haldane, K.C., M.P.; the Right Hon. Sir West Ridgeway, G.C.M.G., K.C.B.; Sir William H. White, K.C.B., F.R.S.; Mr. Julius Wernher; Mr. Almeric W. Fitz Roy, C.V.O., Clerk of the Privy Council; Sir Thomas Wrightson, Bart., M.P.; Mr. S. Neumann; Mr. R. L. Morant, C.B., Permanent Secretary, Board of Education; Sir William H. Preece, K.C.B., F.R.S.; the President of the Institution of Electrical Engineers (Mr. Alex. Siemens); Sir Archibald Geikie, Sec. R.S.; Mr. F. G. Ogilvie, Principal Assistant Secretary, Board of Education; the Deputy-President of the Society of Chemical Industry, etc.



# CONTRACTORS' NEWS.

We shall be pleased to insert under this column, free of charge, particulars of open contracts.

## CONTRACTS OPEN.

Last Day.

**Barrow-in-Furness.**—Construction of a steel road bridge over the Walney Channel, uniting Barrow Island and Walney Island. The bridge will be about 1,123 ft. in total length between abutments and 50 ft. in length, and will consist of eight fixed girder-spans, and one opening span, on cylinder foundations. Sir Benjamin Baker, K.C.B., 2, Queen Square Place, Queen Anne's Mansions, Westminster ... May 15

**Dublin.**—An electric generating station, for the Dublin Port and Docks Board. The specification and drawings can be obtained at the office of the engineer of the Board, Mr. John P. Griffith, M.I.C.E., East Wall, Dublin ... May 15

**Irvine.**—Supply and erection of (1) buildings; (2) power-house plant (suction-gas plant, gas engines and generators, balancers and boosters, battery of accumulators, switch-board and crane); (3) mains (cable trenches, etc., converting street lamps, meters). Messrs. Kirkland and Capper, 17, Victoria Street, Westminster, London, S.W. ... May 15

**London.**—Supply and erection at its generating station (East Greenwich, S.E.) and maintenance for ten years, of a battery of 280 accumulator cells having capacities of 645 ampere hours at a three-hour discharge rate and of 450 ampere hours at a one-hour discharge rate. Specifications, etc., at the County Hall, Spring Gardens, S.W. ... May 16

**Erith.**—Dredging in the River Thames, in front of the Crossness outfall works, in the parish of Erith, in the county of Kent, for the London County Council. Chief engineer, Mr. Maurice Fitzmaurice, C.M.G., County Hall, Spring Gardens, S.W. ... May 16

**Keighley.**—The Electricity Committee invite tenders for superheaters. Mr. Alfred Lister, Borough Treasurer, Town Hall ... May 20

**Colchester.**—Laying of 6-in. to 10-in. cast-iron mains and other works for the Corporation. Mr. C. E. Bland, Waterworks Superintendent, Town Hall ... May 22

**Newton Abbot.**—Construction of a reservoir to contain 10,000 gallons, and for providing and laying about 1,210 yards of 3-in. cast-iron water-mains, with the necessary valves, hydrants, etc., for the Newton Abbot Rural District Council. Mr. Samuel Segar, Union Street, Newton Abbot ... May 24

**Aldeburgh.**—Supplying, erecting, setting to work, and maintaining in good order for three months at the new well, near Aldeburgh Hall Farm, of two "Hornsby-Ackroyd" cheap fuel oil engines, two "Hayward-Tyler" Universal pattern pumps, with all necessary gearing, shafting, pipes, valves, and other fittings, for the Corporation. Particulars of Mr. J. C. Gordon, Aldeburgh, or Messrs. James Mansergh and Sons, 5, Victoria Street, Westminster ... May 24

**London, N.E.**—For the Hackney Borough Council, an artesian well and air-lift pumping plant. Mr. Robert Hammond, M.I.C.E., consulting engineer to the Council, 64, Victoria Street, Westminster, S.W. ... May 25

**Great Western Railway.**—Supply of about 213 tons of steel bridge girders and other steel and iron work of British manufacture for the Great Western Railway Company. The Engineer, Paddington Station ... May 30

**Glasgow.**—Supply, delivery, and erection of the alternative equipment of the machinery buildings of the Glasgow main drainage works, for the Corporation; including both steam and gas installations and steam installation with stand-by installations worked with town gas. Mr. W. S. Hamilton, Bath Street, Glasgow ... June 1

**Hartlepool.**—Construction of a self-propelling barge-loading dredger, capable of lifting 600 tons per hour and of dredging to a depth of 40 ft. below water level; also for the construction of a twin-screw steam hopper barge (hopper capacity 500 tons, speed nine knots loaded), for the Hartlepool Port and Harbour Commission. Mr. J. D. Howkins, engineer, Hartlepool ... June 15

**New South Wales.**—Tenders will be received at the office of the Secretary for Public Works, Sydney, Australia, up to 2 o'clock p.m. on Friday, September 1st, 1905, for the manufacture, supply and delivery in the State of New South Wales of all iron and steel required by the Government. Full particulars may be obtained from the Agent-General's office, 9, Victoria Street, London, S.W. ... Sep. 1

## COMING CONTRACTS.

**Edinburgh.**—The Corporation have under consideration a proposal for increasing the gas and electric lighting of the city at a cost of £4,000.



**Frome.**—Sanction has been granted to a loan of £6,900 for the purposes of electricity.

**Seaton.**—An inquiry has been held into an application by the Council for sanction to borrow £3,000 for waterworks extension.

**Hull.**—An inquiry has been held into a proposal by the Corporation to borrow £20,873 for the purpose of telephonic extension.

**Portsmouth.**—Tenders for two sewage extensions, including two small pumping stations and two rising mains, will shortly be required by the Corporation. These works will entail an expenditure of £36,000.

**Basford.**—An inquiry has been held into the application of the Corporation to borrow £23,300 for the provision of a refuse destructor and health depot.

**Aston Manor.**—The Corporation have adopted the recommendation of the Public Works Committee that tenders for the overhead electrical equipment of the remaining tramways within the borough should be forthwith invited.

**Halifax.**—The recommendation of the Waterworks Committee to lay six miles of 18-in. pipes from Albert reservoir to Brighouse, at an estimated cost of £22,000 has been adopted.

## CONTRACTS CLOSED.

**Dutch State Railway.**—An important order for twenty large locomotives has been received by Messrs. Beyer, Peacock and Co., Ltd., Gorton, Manchester, for the Dutch State Railways.

**Chelsea.**—The Lancashire Steam Motor Company, Ltd., has received a repeat order from the metropolitan borough of Chelsea for one of its standard combined tip wagons and 1,000-gallon watering tank.

**Egyptian State Railways.**—It is stated that after experimenting with American productions, the Egyptian State Railway department have placed an important order for patent bogies and steel wagons with the Leeds Forge Company.

**Barking.**—The Council have accepted the tender of Babcock and Wilcox for a watertube boiler, steam feed pump, water softener and storage tank, etc., at £1,638, and that of Davey, Paxman and Co., for a 400 kw. steam dynamo, switchboard panels, etc., at £2,530 17s.

**Bolton.**—The Electricity Committee have accepted the tender of Musgrave and Sons for cooling towers, that of the British Insulated and Helsby Cables for supply of cables.

**Aberdeen.**—The Corporation have accepted the tender of W. H. Bailey and Co. for a surface condenser with air pump, oil separator, etc. at £1,036.

**South Shields.**—The Corporation have accepted the tender of Hurst, Nelson and Co. for ten tram-cars at £5,307, subject to the trucks being British-made of the Brill standard type, and guaranteed for three years.

**San Paulo Railway.**—J. Sagar and Co., Ltd., have just supplied, to the order of the San Paulo Railway Company, of Brazil, one of the firm's improved log cross cutting machines, suitable for cutting logs up to 48 in. diameter.

**Durham.**—The Durham Collieries Electric Power Company, Ltd., have arranged a contract for the supply of power to the Hetton Coal Company. It is proposed to use the power for hauling, pumping, coal cutting, lighting, etc., at the company's extensive collieries at Eppleton, Lyons, and Elemore. The Power Company are also to supply the collieries of the Lambton Collieries Company, as well as the estate of Lord Durham.

**Wigan.**—The Corporation have accepted the tender of Dick, Kerr and Co., Ltd., for steam dynamos and accessories at £2,595, of Tickle Bros., Wigan, for steam piping, etc., at £742, and of Johnson and Phillips for paper and service cables, etc., at £1,199.

**Derby.**—The Council have accepted the tender of the St. Helens Cable Co., for electrical plant at £860.

**Keighley.**—The Corporation have accepted the tender of the Phoenix Dynamo Co., for the supply of a 300 kw. direct-current dynamo and high-speed steam engine.

## APPOINTMENTS VACANT.

Last Day.

**East London, South Africa.**—The Municipality of East London, South Africa, require a town electrical engineer. Salary £500 per annum. Applications to Messrs. Dyer and Dyer, 17, Aldermanbury, London, E.C., agents for the Municipality of East London ... May 18

**Carrick-on-Suir.**—Required for the Carrick-on-Suir Gasworks, Ireland, a manager, immediately. Applications to Mr. R. Bruce Anderson, 5, Westminster Chambers, Victoria Street, E.C. ....

**Burton.**—Surveyor and sanitary inspector. Salary £150. Applications to Mr. W. H. Redgate, clerk to the Council, Bentinck Buildings, Wheeler Gate, Nottingham ... May 19

**Birmingham.**—A professor of civil engineering at the university. Salary £600 per annum. Applications to Mr. Geo. H. Morley, Secretary, Birmingham University ... May 20

**Johannesburg.**—General manager to take charge of tramways lighting and power undertakings. Salary £2,000 per annum. A station engineer to take charge of generating station and tramways workshops. Salary £1,000 per annum. Applications to Messrs. Morley and Dawbarn, 82, Victoria Street, Westminster ... May 29

## APPOINTMENTS FILLED.

**Leeds.**—The Leeds City Council have confirmed the appointment of Mr. George Adam Hart, assistant engineer to the Birmingham Tame and Rea Drainage Board, as sewerage engineer to the city at a salary of £1,000 per annum.

**London.**—Mr. Charles James Cater-Scott (chairman of the London and India Docks Company) has been elected a director and appointed chairman of the London United Tramways.



# Share List of Engineering, Electrical, Iron and Steel, and other Companies.

The following is a comprehensive list of Companies in the industries covered by "Page's Weekly," in which shares business is being currently transacted. Additions will be made from time to time as occasion requires. We desire it to be understood that while our Share List will generally be found correct, we do not hold ourselves responsible for any loss or inconvenience that may arise from possible inaccuracies.

STOCK EXCHANGE SETTLING DAYS.—Settling days on the Stock Exchange are as follows:—

Consols: June 1st.

General Settlements: May 31st, June 15th, 29th.

Bank Rate, March 9th, 1905, 2½ per cent.

## I.—ENGINEERING, IRON, AND STEEL COMPANIES.

## ENGINEERING, IRON, AND STEEL COMPANIES.—Contd.

Present Amount Subscribed.	Shares.	Last Dividend.	Name.	Paid up.	Closing Prices.	Present Amount Subscribed.	Shares.	Last Dividend.	Name.	Paid up.	Closing Prices.
11,370	5	5%	Alldays & Onions Pneumatic Engineering, Ltd.	3	23 — 3	750,000	1	6d.	Howard & Bullough, Ltd., Ord.	1	18 — 12
10,000	5	3/-	Do. Cum. Pref. 6 per cent.	5	48 — 48	25,000	10	6/-	Do. 6% Pref. (Non-Cum.)	10	13 — 12½
8,210,000	1	1/-	Armstrong (Sir W. G.), Whitworth and Co., Ltd.	1	8½ — 8½	£250,000	Stk	4%	Do. 4% Deb. Stk., Red. after 1906	100	98 — 101
76,970	5	2/-	Do. 4% Cum. Pref.	5	52 — 52	37,500	10	20	Kynoch, Ltd.	10	18 — 19
1,500,000	100	4%	Do. 4% 1st Mort. Dbs. Rd.	100	102 — 104	49,587	10	5%	Do. Cum. Pref. 5%	10	10 — 11
£100,000	100	4½%	Aveling and Porter, Ltd., 4½% Reg. Mt. Dbs. Red.	100	96 — 99	300,000	1	4½d	Lambert Bros., Ltd., Ord.	1	2 — 2
530,000	1	2/4½	Babcock and Wilcox, Ltd., Ord.	1	5½ — 5½	50,000	5	2/9	Do. 5½% Cum. Pref.	5	4 — 4½
100,000	1	7½d.	Do. 6% Cum. Pref.	1	1½ — 1½	40,000	3	2/1½	Leeds Forge Co., 7% Cum. Pref.	3	32 — 4
20,000	5	3/-	Baker (Joseph) and Sons, Ltd., 6% Cum. Pref.	5	42 — 52	200,000	1	7½d.	Lysaght (John), Ltd., 6% Cum. Pf.	1	12 — 18*
250,000	1	6½d.	Baldwins, Ltd., 6½% Cum. Pref.	1	1½ — 1½	£300,000	Stk	4½%	Do. 4½% 1st Mt. Deb. Stk., Red.	100	109 — 111
£250,000	Stk	4½%	Do. 1st Mt. 4½% Deb. Stk. Red.	100	102 — 105	40,000	10	5/-	Mather & Platt, Ltd., 5% Cum. Pref.	10	112 — 114
150,000	4½	2/8½	Barrow Hematite Steel Co., Ltd., O.	4½	1½ — 1½	210,000	1	6½d.	Measures Bros., Ltd., Ord.	1	18 — 18
50,000	4½	3/-	Do. do. Cum 2nd. Pref.	4½	4½ — 4½	75,000	1	6½d.	Do. 5½% Cum. Pref.	1	18 — 18
33,334	5	2/6	Bayliss, Jones and Bayliss, Ltd., 5% Cum. Pref. Shares	5	42 — 52	£75,000	Stk	4½%	Do. 4½% 1st Mrt. Db. Stk., Red.	100	92 — 95
£500,000	100	—	Beardmore (Wm.) & Co., Ltd., 4½% 1st Mt. Dbs., Red. Scrip 50% pd	—	104 — 106	21,948	5	2/6	Muntz Metal, Ltd.	5	48 — 56
50,000	10	6/-	Bell Brothers, Ltd., 6% Cum. Pref.	10	112 — 122	14,248	5	5%	Do. Pref. 5%	5	48 — 56
£266,600	Stk	4%	Do. 4% Deb. Stock, Red.	100	99 — 101	78,000	10	5/-	N. Brit. Loco. Co., Ltd., 6% Cum. Pf.	62½	78 — 81
200,000	1	1/-	Beyer, Peacock and Co., Ltd., Ord.	1	76 — 76	80,000	5	—	North-Eastern Steel Co., Ltd.,	10	12 — 12½
300,000	1	6½d.	Do. 5½% Cum. Pref.	1	— — —	£250,000	Stk	4½%	Do. 4½% 1st Mrt. Db. Stk., Red.	100	90 — 93
£300,000	Stk	4½%	Do. 4½% Red. Deb. Stock	100	96 — 99	122,000	5	1/6	Pearson & Knowles Coal and Iron Co., Ltd., Ord., "B"	5	3½ — 4½
1,629,760	1	6d.	Bolckow, Vaughan and Co., Ltd., O.	1	1½ — 1½	50,000	5	3/-	Do. 6% Cum. Pref. "A"	5	56 — 62
1,860,900	1	3½d.	Do. Nos. 1,639,101-8,500,000	12½	1 — 1½	70,000	10	6/-	Pease & Partners, Ltd., Ord.	10	94 — 10
1,160,000	1	4½d.	Brown (John) and Co., Lim., Ord.	15½	1½ — 1½	£400,000	Stk	4%	Do. 4% Perp. Deb. Stock	100	97 — 100*
590,000	1	6d.	Do. Ord., Nos. 1,160,001-1,750,000	1	122 — 122	20,000	5	3/-	Peebles (Bruce) & Co., Ltd., 6% Cum. P.	5	42 — 5
74,000	10	5/-	Do. 5% Cum. Pref.	10	11 — 11½	65,000	1	—	Pooley (Henry) & Son, Ltd., Ord.	1	6½ — 6½
154,500	5	5/-	Cammell, Laird & Co., Ltd., Ord.	5	58 — 82	19,000	5	—	Do. 5½% Cum. Pref.	5	48 — 48
282,500	5	2/6	Do. 5% Cum. Pref.	5	58 — 58½	230,000	1	—	Projectile Co. (1902), Ltd., Ord.	1	18 — 2
450,000	1	1/22	Clayton & Shuttleworth, Ltd., Ord.	1	13 — 13	73,062	5	2/-	Rhymney Iron Co., Ltd.	5	12 — 12
70,000	5	2/6	Do. 5% Cum. Pref.	5	58 — 58*	£390,000	—	5%	Do. New	5	12 — 12
£250,000	Stk	4%	Do. 4% 1st Mort. Db. Stk. Red	100	100 — 103	350,000	1	7½d.	Do. 5% Mort. Deb., Red.	100	101 — 103
100,000	10	7/6	Consett Iron Co., Ltd., Ord.	7½	81½ — 82½	£350,000	Stk	4½%	Richardsons, Westgarth & Co., Ltd., Ord. 850,001-700,000	1	2 — 18
57,031	10	10/-	Crossley, Bros., Ltd. Ord. 40340/97870	10	16 — 16½	36,000	10	12/-	Do. 4½% Perp. Deb. Stock	100	94 — 96
40,839	10	5%	Do. 5% Cum. Pref.	10	112 — 12	275,000	1	6d.	Ruston, Proctor & Co., Ltd., Ord.	10	94 — 10
75,000	1	2/6	Delta Metal, Ltd., Shares	1	2 — 2½	300,000	1	7½d.	Scott (Walter) Ltd., Ord.	1	18 — 18
1,259,594	1	3½d.	Dorman, Long & Co., Ltd.	1	1 — 1½	£300,000	Stk	4%	Do. 6% Cum. Pref.	1	18 — 18
£400,000	Stk	4%	Do. 4% 1st Mort. Perp. Deb. Stk.	100	91 — 94	£115,900	100	5%	Do. 4% Perp. Deb. Stk.	100	94 — 96
200,000	5	3/-	Dunderland Iron Ore Co., Ltd., 6% Cum. Pref. and Participating.	5	38 — 38	£97,900	100	6%	Shelton Iron, Steel and Coal Co., Ltd. 1st Charge 5% Dbs., Red.	100	98 — 96
250,000	1	9½d.	Dunlop (James) & Co., Ltd., Ord.	1	1 — 1½	250,000	1	1/22	Do. 6% 2nd Mort. Dbs., Red.	100	91 — 95
300,000	1	7½d.	Do. 6% Cum. Pref.	1	1 — 1½	£300,000	Stk	4½%	South Durham Steel & Iron, Ltd., Ord.	1	8 — 18
4,721	13	12/-	Ebbw Vale Steel, Iron & Coal Co., Ltd.	13	92 — 102	300,000	1	1/22	Do. 6% Cum. Pref.	1	18 — 18
69,754	13	12/-	Do. do. do.	10	78 — 78	£300,000	Stk	4½%	Do. 4½% Perp. Deb. Stk.	100	89 — 92
20,250	10	8/-	Elliott's Metal, Ltd.	8	42 — 42	49,560	10	2½%	Steel Co. of Scotland Ord. 1/49560.	9	52 — 58
5,000	10	5%	Do. Cum. Pref. 5%	10	82 — 92	£125,240	Stk	5%	Do. 5% Trust Mort. Deb.	100	100½ — 107½
186,748	Stk	4%	Do. Deb. 4%	100	94½ — 96½	25,000	10	—	Stephenson (Robert) & Co., Ltd., Or.	10	2 — 2½
25,000	10	6/-	Fairfield Shipbuilding & Engng. Co., Ltd., 6% Cum. Pref.	10	11 — 11½	£250,000	Stk	4%	Do. 5½% Cum. Pref.	10	4 — 4½
£250,000	Stk	4½%	Do. 4½% Mort. Deb. Stk. Red.	100	100 — 103	85,000	10	9/-	Do. 4% Perp. Deb. Stk.	100	77 — 80
9,000	10	10%	Fleming & Ferguson, Ltd. Ord. Nos. 1/9000.	10	12 — 12½	55,000	10	6/-	Stewarts & Lloyds, Ltd., Ord.	10	17½ — 18
6,000	10	5%	Do. 5% Cum. Pref. Nos. 9001/15000	10	9½ — 10	634,732	1	6d.	Do. 6% Cum. Pref.	10	14½ — 15
126,000	3	3/-	Fraser & Chalmers, Ltd., Ord.	3	48 — 48	538,845	1	6d.	Swan, Hunter & Wigham-Richardson, Lim. Ord.	1	3 — 8
21,000	3	1/6	Do. 7½% Cum. Pref.	3	52 — 62	£240,000	Stk	4½%	Do. 5% Cum. Pref.	1	3 — 1
10,000	10	5%	Galloways, Ltd., 5% Cum. Pref.	10	6 — 7	300,000	1	6d.	Do. 4½% 1st Mort. Deb. Stk. Red	100	98 — 101
£150,000	Stk	4%	Do. 4% 1st Mort. Deb. Red.	100	90½ — 91½	10,000	10	5/-	Thames Iron Works, Shipbuilding & Engineering Co., Ltd., 5% Cum. Pf.	1	2 — 18
16,800	10	—	Greenwood & Batley, Ltd., Ord.	10	42 — 42	£360,311,100	£100	£12	Do. 4% Irredeem. 1st Mort. Deb.	100	76 — 80
9,600	10	7%	Do. 7% Cum. Pref.	10	102 — 103	£162,268,000	£1000	5%	Thornycroft (John I.) & Co., Ltd. 6% Cum. Pref.	1	18 — 18
965,000	1	1/2	Guest, Keen & Nettlefolds, Ltd. Ord.	1	2½ — 2½	3,350,000	1	1/6	Tylor (J.) & Sons, Ltd., 6% Cum. Pf.	10	94 — 10
344,000	5	2/6	Do. 5% Cum. Pref.	5	5 — 6	750,000	1	6d.	United States Steel Corp. Cum. Stk.	£100	322 — 323
£1,850,500	Stk	4%	Do. 4% Irred. Mort. Deb. Stk.	100	105 — 107	£2,750,000	Stk	5%	Do. 7% Cum. Pref. Stock Stk.	£100	103 — 108½
13,000	5	2/6	Gwynnes, Ltd., 5% Cum. Pref.	5	2 — 3	£1,250,000	Stk	4%	Do. 10-40yr. 5% Skg. Fd. G. Bds.	£1000	96 — 98
250,000	1	3/6	Hadfield's Steel F'ry Co., Ltd., Ord.	1	92 — 38	£1,000,000	100	4½%	Vickers, Sons & Maxim, Ltd. Ord.	1	2½ — 2½
20,000	10	4/6	Do. 4½% Cum. Pref.	10	102 — 112	225,000	1	1/22	Do. 5% Non-Cum. Pref.	1	1½ — 1½
30,000	5	3/-	Hall (J. & E.), Ltd. 6½% Cum. Pref.	5	5 — 5½	500,000	1	7½d.	Do. 5% Non-Cum. Pref. Stock	100	118 — 121
408,505	1	1/6	Harvey United Steel Co., Ltd.	1	1½ — 1½	7,637	5	2/9	Do. 4% 1st Mort. Deb. Stk. Red.	100	107 — 109
47,600	10	7½d.	Hawthorn, Leslie & Co., Ltd. Ord.	10	102 — 11	£300,000	Stk	4%	Do. 4½% 2nd Mort. Dbs., Red.	100	106 — 109
24,001	5	3/-	Head, Wrightson & Co., Ltd.	5	5 — 5½	7,637	5	2/9	Weardale Steel, Coal & Coke, Ltd., Def. Ord.	1	18 — 18
85,000	1	7½d.	Hill (Richard) & Co. (1899) Ltd., Ord.	1	1½ — 1½	£300,000	Stk	4%	Do. 6% Cum. Pref. Ord.	1	1 — 1
18,000	5	3/-	Do. 6% Cum. Pref.	5	42 — 5	7,637	5	2/9	Do. 4% Perpetual Deb. Stock	100	81 — 85*
30,000	10	6/-	Hornsby (Richard) & Sons, Ltd., Ord.	8	5½ — 6	£246,641	Stk	4%	Weldless Steel Tube, Ltd., Cum. Pref. 5½	5	48 — 48
			Howard & Bullough, Ltd., Ord.	10	18 — 12	£150,000	Stk	4½%	Do. Mort. Deb. 4½%	100	92 — 98
			Do. 6% Pref. (Non-Cum.)	10	18 — 10½				Williams & Robinson, Ord.	5	1 — 2
			Do. 4% Deb. Stk., Red. after 1906	100	98 — 101				Do. 6% Cum. Pref.	5	1½ — 2½
			Kynoch, Ltd.	10	18 — 19				Do. 4% 1st Mort. Deb. Stk. Red.	100	75 — 80
			Do. Cum. Pref. 5%	10	10 — 11				Yorkshire Iron & Coal Co., Ltd., 4½% 1st Mort. Deb. Stk. Red.	100	— 78
			Lambert Bros., Ltd., Ord.	1	4 — 5						
			Do. 5½% Cum. Pref.	5	38 — 4						
			Leeds Forge Co., 7% Cum. Pref.	3	32 — 4						
			Lysaght (John), Ltd., 6% Cum. Pf.	1	12 — 18*						
			Do. 4½% 1st Mt. Deb. Stk., Red.	100	109 — 111						
			Mather & Platt, Ltd., 5% Cum. Pref.	10	112 — 114						
			Measures Bros., Ltd., Ord.	1	18 — 18						
			Do. 5½% Cum. Pref.	1	18 — 18						
			Do. 4½% 1st Mt. Db. Stk., Red.	100	92 — 95						
			Muntz Metal, Ltd.	5	48 — 56						
			Do. Pref. 5%	5	48 — 56						
			Nantyglo and Blaina Iron Works, Ltd., 8% Cum. Pref.	62½	78 — 81						
			Do. 4½% 1st Mt. Db. Stk., Red.	100	90 — 93						
			Pearson & Knowles Coal and Iron Co., Ltd., Ord., "B"	5	3½ — 4½						
			Do. 6% Cum. Pref. "A"	5	56 — 62						
			Pease & Partners, Ltd., Ord.	10	94 — 10						
			Do. 4% Perp. Deb. Stock	100	97 — 100*						
			Peebles (Bruce) & Co., Ltd., 6% Cum. P.	5	42 — 5						
			Pooley (Henry) & Son, Ltd., Ord.	1	6½ — 6½						
			Do. 5½% Cum. Pref.	5	48 — 48						
			Projectile Co. (1902), Ltd., Ord.	1	18 — 2						
			Rhymney Iron Co., Ltd.	5	12 — 12						
			Do. New	5	12 — 12						
			Do. 5% Mort. Deb., Red.	100	101 — 103						
			Richardsons, Westgarth & Co., Ltd., Ord. 850,001-700,000	1	2 — 18				</		



## II.—ELECTRICAL MANUFACTURING COMPANIES.

Present Amount Subscribed.	Shares.	Last Dividend.	Name	Paid up.	Closing Prices.
70,000	1	6d.	Alliance Elec. Co., Ltd. 5% Cum. Pf.	1	8 — 8
125,000	1	7½d.	Aron Elec. Meter Ltd., 6% Cum. Pf.	1	18 — 18½
120,000	1	1½d.	Bell's Asbestos Co., Ltd.	1	18 — 18
100,000	5	4/-	British Insulated & Helsby Cables Ltd., Ord.	5	54 — 6
100,000	5	3/-	Do. 6% Cum. Pref.	5	54 — 6
£500,000	Stk	4½%	Do. 4½ 1st Mort. Deb. Stk. Rd.	100	102 — 105
£200,000	Stk	4½%	British Thomson-Houston Co., Ltd., 4½ 1st Mort. Deb. Stk. Rd.	100	100 — 102
400,000	5	3/-	British Westinghouse Electric and Manufac. Co., Ltd., 7% Pref.	5	2½ — 8½
£616,858	Stk	4%	Do. 4% Mort. Deb. Stk. Rd.	100	90 — 92
105,781	2	2/-	Brush Elec. Enging. Co., Ltd., Ord.	2	4 — 2
150,000	2	2½d.	Do. 6% Pref.	2	12 — 2
£125,000	Stk	4½%	Do. 4½ Perp. 1st Deb. Stk.	100	92 — 95
£125,000	Stk	4½%	Do. 4½ Perp. 2nd Deb. Stk.	100	79 — 82
35,000	5	5/-	Callender's Cable & Constn. Ltd. Ord.	5	11 — 11½
40,000	5	2/6	Do. 5% Cum. Pref.	5	52 — 56
£200,000	Stk	4½%	Do. 4½ 1st Mort. Deb. Stk. Rd.	100	107 — 109
85,000	3	1/6	Crompton & Co., Ltd.	3	2 — 2½
£100,000	—	5%	Do. 5% 1st Mort. Reg. Debs.	100	95 — 100*
52,000	5	10/-	Dick, Kerr & Co., Ltd., Ord.	5	7½ — 8
161,000	5	3/-	Do. 6% Cum. Pref.	5	5½ — 6
£300,000	Stk	4½%	Do. 4½ Deb. Stock, Red.	100	105 — 107
293,334	1	6d.	Doulton & Co., Ltd., 5% Cum. Pref.	1	1½ — 1½
£233,334	Stk	4%	Do. 1st Mort. 4% Free Deb. Stk.	100	106 — 109
99,261	5	1/6	Edison and Swan United Electric Light, Ltd., "A" Shares Nos. 1-99,261	5	1 — 1½
17,189	5	2/6	Do. "A" Shares Nos. 01-17,189	5	12 — 2½
£344,028	Stk	4%	Do. 4% Deb. Stock Red.	100	82 — 87
£100,000	Stk	5%	Do. 5% Second Deb. Stk. Red.	100	87 — 92
112,100	2	1/7½	Electric Construction Co., Ltd.	2	4 — 1½
31,390	2	2/9½	Do. 7% Cumulative Pref.	2	24 — 2½
£200,000	Stk	4%	Do. 4% Perp. 1st Mt. Deb. Stk.	100	97 — 99
10,248	10	7/6	Evered and Co., Ltd.	10	11 — 13
£100,000	Stk	5%	Ferranti, Ltd., 5% 1st Mort. Deb. Stock, Red.	100	90 — 95
25,000	10	5/-	Gen. Elect. Co. (1900), Ltd., 5% Cum. Pref.	10	9½ — 10
£200,000	Stk	4%	Do. 4% 1st Mt. Deb. Stk., Red.	100	97 — 101
35,000	5	10/-	Henley's (W. T.) Telegraph Works Co., Ltd., Ord.	5	11 — 12
35,000	5	2/8	Do. 4½ Cum. Pref.	5	5½ — 5½
£50,000	Stk	4½%	Do. 4½ Mt. Deb. Stk. Red.	100	109 — 111
50,000	10	5/-	India Rubber, Gutta Percha & Telegraph Works Co., Ltd., 1st Mort. Deb. Red.	10	16 — 17
£300,000	100	4%	Do. 1st Mort. Deb. Red.	100	100 — 108
7,500	10	—	Parker, Thos., Ltd.	10	6½ — 7
100,000	1	3%	Scott (Ernest) & Mountain, Ltd., Ord.	1	16½ — 16½
37,350	12	2½/-	Telegraph Construction and Maintenance Co., Ltd.	12	35 — 37
£150,000	100	4%	Do. 4% Deb. Bonds	100	103 — 105

## III.—ELECTRIC TRACTION.

Present Amount Subscribed.	Shares.	Last Dividend.	Name	Paid up.	Closing Prices.
120,000	5	5/-	Anglo-Argentine Trams Co., Ltd., Ord.	5	5½ — 6½
260,007	5	2/6	Do. 5% Cum. Pf.	5	5½ — 6½
£230,000	Stk	6%	Do. Permanent 6% Debenture Stock, 1888	100	140 — 148
20,000	10	12/-	Barcelona Trams Co., Ltd., Ord.	10	11½ — 11½
10,000	10	5/-	Do. 5% Cum. Pf. Shares	10	9½ — 10½
£46,300	100	5%	Do. 5% Debs., Red.	100	99 — 102
£191,326	Stk	4½%	Do. 4½ Red. Deb. Stk.	100	96 — 100
75,606	1	—	Bath Elec. Trams, Ltd., Pf. Ord.	1	3 — 4
59,394	1	11½d.	Do. 5% Cum. Pf.	1	10 — 10½
75,000	5	—	Brisbane Electric Tram Investment Co., Ltd., Ord.	5	1 — 1½
75,000	5	2/6	Do. 5% Cum. Pf.	5	32 — 4½
£425,000	Stk	4½%	Do. 4½ 1st Deb. Stk., Red.	100	94 — 98
£200,000	Stk	6%	Brit. Columbia Elec. Ry. Co., Ltd., Def. Ord. Stock	100	103 — 106*
183,301	10	6/-	Do. Pref. Ord. Stock	100	100 — 103
156,487	10	6/-	Brit. Electric Traction, Ltd., Ord.	10	9½ — 9½
£1,000,000	Stk	5%	Do. 6% Cum. Pref.	100	103 — 11½
£250,000	Stk	4½%	Do. 5% Perp. Deb. Stk.	100	121 — 123
100,000	5	2/6	Do. 4% 2nd Deb. Stk. Red.	100	96 — 98*
40,500	5	3/-	Buenos Ayres & Belgrano Electric Trams, Ltd., Ord.	5	3½ — 3½
27,000	5	3/-	Do. "A" 6% Cum. Pref.	5	5½ — 5½
			Do. "B" do.	5	5½ — 5½

## ELECTRIC TRACTION.—Contd.

Present Amount Subscribed.	Shares.	Last Dividend.	Name	Paid up.	Closing Prices.
£200,000	Stk	5%	Buenos Ayres Elec. Trams Co. (1901) Ltd., 5% Db. Stk., Red.	100	97 — 99
£220,000	100	6%	Buenos Ayres Gd. Nat., Ltd., 6% 1st Deb. Bds.	100	101 — 105
102,268	5	5/-	Calcutta Tramways Co., Ltd.	5	9½ — 8½
£350,000	Stk	4½%	Do. 4½ 1st Deb. Stk., Red.	100	107 — 109
480,000	1	8d.	Cape Electric Tramways, Ltd.	1	12 — 14
40,000	5	2/6	City of Birmingham Trams Co., Ltd., 5% Cum. Pref.	5	4½ — 5½
£800,000	100	4%	Do. 4% 1st Mort. Debs.	100	99 — 102
£120,000	Stk	5%	Colombo Elec. Tram. & Light. Co., Ltd., 5% 1st Mort. Deb. Stk. Red.	100	101 — 108*
60,000	10	6/-	Dublin United Trams Co. (1896), Ltd., Ord.	10	13½ — 14½
59,987	10	6/-	Do. 6% Pref.	10	15½ — 16½
30,000	5	2/6	Isle of Thanet Elec. Trams. and Light. Co., Ltd., 5% Cum. Pref.	5	22 — 32
£150,000	Stk	4%	Do. 4% Deb. Stock	100	85 — 90
125,000	10	5/-	London United Trams, (1901), Ltd., 5% Cum. Pref.	10	10 — 10½
£1,031,000	Stk	4%	Do. 4% 1st Mort. Deb. Stk. Red.	100	99 — 102
£50,000	Stk	5%	Madras Electric Trams (1904), Ltd., 5% Deb. Stock, Red.	100	101 — 103
314,016	1	—	Metropolitan Elec. Trams, Ltd., Def.	1	8 — 7½
500,000	1	—	Do. 5% Cum. Pref.	1	1 — 1½
£350,000	Stk	4½%	Do. 4½ Deb. Stock, Red.	100	105 — 107
50,000	5	6/-	New General Traction Co., Ltd., 6% Cum. Pref.	5	3 — 1½
110,923	8	3/2½	North Metropolitan Tramways Co., Ltd., 5% 1st Mort. Debs.	100	90 — 95
£150,000	100	3½%	Do. 3½ 1st Mort. Deb. Stk., Red.	100	105 — 108
£196,200	Stk	5%	Perth Electric Trams, Ltd. (W.A.), 5% 1st Mort. Deb. Stock, Red.	100	9 — 9½
24,500	10	10/-	Potteries Elec. Traction Co., Ltd., Ord.	10	9½ — 9½
24,500	10	5/-	Do. 5% Cum. Pref.	10	9½ — 9½
£220,000	Stk	4½%	Do. 4½ Deb. Stk., Red.	100	103 — 107*

## IV.—ELECTRIC LIGHTING AND POWER.

Present Amount Subscribed.	Shares.	Last Dividend.	Name	Paid up.	Closing Prices.
7,500	10	14/-	Bournemouth & Poole Elec. Sup. Co., Ltd., Ord.	10	11½ — 12½
7,500	10	4/6	Do. 4½ Cum. Pref.	10	10 — 10½
7,500	10	6/-	Do. 6% Cum. Second Pf.	10	11 — 12
£70,000	Stk	4½%	Do. 4½ Deb. Stock Red.	100	106 — 108
14,000	5	3/8	Bromley (Kent) Elec. Lt. & Pr. Co., Ltd.	5	5½ — 5½
£50,000	Stk	4½%	Do. do. 4½ 1st Deb. Stk. Red.	100	101 — 104*
27,507	5	5/6	Brompton & Kensington Elec. Supply Co., Ltd., Ord.	5	9½ — 10½
12,493	5	3/6	Do. 7% Cum. Pref. Shares	5	9½ — 10½
60,000	5	3/-	Calcutta Elec. Sup. Cor. Ltd., Ord.	5	9 — 9½
£288,782	Stk	4%	Central Elec. Sup. Co., Ltd., 4% Gna. Deb. Stk.	100	105 — 108
70,000	5	4/-	Charing Cross & Strand Elec. Sup. Corp., Ltd., Ord.	5	7½ — 8½
80,000	5	2/8	Do. do. 4½ Cum. Pref.	5	5 — 5½
£350,000	Stk	4%	Do. do. 4% Deb. Stk. Red.	100	105 — 107
41,436	5	8/9	Chelsea Elec. Sply. Co., Ltd., Ord.	5	6½ — 7
£150,000	Stk	4½%	Do. do. 4½ Deb. Stk., Red.	100	109 — 111
70,595	10	7/-	City of London El. Light. Co., Ltd., O.	10	11½ — 12
40,000	10	6/-	Do. 6% Cum. Pref.	10	10½ — 11½
£400,000	Stk	5%	Do. 5% Deb. Stk., Red.	100	123 — 127
£300,000	Stk	4½%	Do. 4½ 2nd Deb. Stk., Red.	100	108 — 105
40,000	10	5/-	County of London Elec. Supply Co., Ltd., Ord.	10	8½ — 9½
30,000	10	6/-	Do. 6% Cum. Pref.	10	12 — 12½
£400,000	Stk	4½%	Do. 4½ Deb. Stk., Red.	100	111 — 114
70,000	5	2/6	Edmundson's Elec. Cor. Ltd., Ord.	5	52 — 6
70,000	5	3/-	Do. 6% Cum. Pref.	5	6½ — 6½
£300,000	Stk	4½%	Do. 4½ 1st Mort. Db. Stk. Reg.	100	107 — 109
£30,000	Stk	5%	Electric Lighting & Traction Co. of Australia, Ltd. 5% Deb. Stk. Red.	100	86 — 91
10,000	5	6/-	Folkestone Elec. Supply Co., Ltd., O.	5	5½ — 5½
£50,000	Stk	4½%	Do. 4½ 1st Deb. Stk., Red.	100	101 — 104
15,000	10	—	Havana Electricity Co., Ltd.	10	9½ — 10½
13,000	5	5/-	Hove Elec. Lighting Co., Ltd., Ord.	5	7½ — 8
£50,000	Stk	4½%	Isle of Wight Electric Light & Power Co., Ltd. 4½ Deb. Stock, Red.	100	100 — 103*
150,000	1	—	Kalgoorlie Electric Power & Lighting Corp. Ltd., 6% Cum. Pref.	1	2 — 3
21,000	5	7/-	Kensington and Knightsbridge Electric Lighting Co., Ltd., Ord.	5	12½ — 13



## ELECTRIC LIGHTING AND POWER.—Contd.

Present Amount Subscribed.	Shares.	Last Dividend.	Name.	Paid up.	Closing Prices.
£185,000	Stk	4%	Kensington and Knightsbridge Electric Lighting Co., Ltd., and the Notting Hill Electric Lighting Co., Ltd., 4% Deb. Stock, Red.	100	101-103
111,000	8	1/9 <sup>3</sup>	London Elec. Supply Corp., Ltd., Ord.	3	21-22
60,000	5	3/-	Do. 6% Pref.	5	52-52
£871,895	Stk	4%	Do. 4% 1st Mort. Db. Stk., Red.	100	99-101
100,000	10	11/-	Metropolitan Elec. Sup. Co., Ltd., Ord.	10	18-19
76,121	8	2/8	Do. 4% Cum. Pref.	5	52-52
230,000	Stk	4%	Do. 4% 1st Mort. Db. Stk., Red.	100	109-111
250,000	Stk	4%	Do. 8% Mort. Deb. Stk., Red.	100	97-99
£250,000	—	4%	Midland Elec. Corp. for Power Distribution, Ltd., 4% 1st Mort. Deb.	100	99-101
10,852	10	8/-	Notting Hill Elec. Ltg. Co. Ltd., Ord.	10	14-15
£59,000	100	4%	Do. 4% 1st Mort. Debs.	100	100-102
16,500	5	4/6	Oxford Electric Co. Ltd., Ord.	5	62-64
£50,000	Stk	4%	Do. 4% Debenture Stk. Red.	100	98-100
£84,700	100	4%	Royal Elec. Co. (of Montreal) 4% 20-yr. 1st Mort. Deb	100	101-104
40,000	5	9/6	St. James' & Pall Mall Elec. Light Co., Ltd. Ord.	5	14-15
20,000	5	9/6	Do. 7% Pref.	5	82-82
£150,000	Stk	8%	Do. 8% Deben. Stock, Red	100	98-100
12,000	5	4/-	Smithfield Markets Elec. Supply Co., Ltd. Ord.	5	28-31
£50,000	Stk	4%	Do. 4% Debenture Stk. Red.	100	79-83
65,000	5	4/-	South London Elec. Sup. Co., Ltd., O.	5	4-4
100,000	1	—	South Metropolitan Elec. Light & Power Co., Ltd. Ord.	1	18-18
50,000	1	8 <sup>3</sup> / <sub>4</sub> d.	Do. 7% Cum. Pref.	1	17-17
£100,000	Stk	4%	Do. 4% 1st Deb. Stock Red.	100	105-108
50,000	5	2/6	Urban Electric Supply Co., Ltd., O.	5	42-52
30,000	5	2/6	Do. 5% Cum. Pref.	5	52-52
£200,000	Stk	4%	Do. 4% 1st Mort. Deb. Stk. Red.	100	104-106
110,000	5	7/6	Westminster Elec. Supply Corp. Ltd., Ord.	5	12-13
28,151	5	2/6	Do. 5% Cum. Pref.	5	6-6

## V.—TELEGRAPH &amp; TELEPHONE COMPANIES.

Present Amount Subscribed.	Shares.	Last Dividend.	Name.	Paid up.	Closing Prices.
£34,800	100	4%	African Direct Tel. Co., Ltd., 4% Mt. Debs. (Series A), Red.	100	99-102
25,000	10	—	Amazon Telegraph Co., Ltd.	10	24-23
£763,580	Stk	15/-	Anglo-American Tel. Co., Ltd., Ord.	100	60-62
£3,118,210	Stk	30/-	Do. 6% Preferred Ordinary	100	106-107
£3,118,210	Stk	2/-	Do. Deferred Ordinary	100	15-15
44,000	5	3/-	Chili Telephone Co., Ltd.	5	68-66
£15,000,000	£100	52	Commercial Cable Co., Capital Stk.	£100	97-99
£1,903,856	Stk	4%	Do. Sterl. 500-yr 4% Deb. Stk., Red.	100	81-83
16,000	10	5/-	Cuba Submarine Tel. Co., Ltd., Ord.	10	15-16
6,000	10	10/-	Do. 10% Preference	5	38-38
6,000	5	2/-	Direct Spanish Telegraph Co., Ord.	5	68-68
£30,000	50	4%	Do. 10% Cum. Preference	50	101-103
60,710	20	3/-	Do. 4% Debs.	20	11-11
£85,800	100	4%	Direct U.S. Cable Co., Ltd.	100	100-102
£300,000	100	4%	Direct West India Cable Co., Ltd., 4% Reg. Debs.	100	100-102
£200,000	25	4%	East. & S. African, Ltd., 4% Mt. Dbs. (Mauritius Subsidy)	25	99-101*
300,000	10	2/6	Eastern Extension, Australasia and China, Ltd.	10	14-14
£602,400	Stk	4%	Do. 4% Mort. Deb. Stk., Perp.	100	105-107
£1,000,000	Stk	25/-	Eastern Tele. Co., Ltd., Ord.	100	139-142
£2,000,000	Stk	17/6	Do. 8% Pref.	100	91-93
£1,888,814	Stk	4%	Do. 4% Mort. Deb.	100	107-109*
150,000	10	5/-	Great Northern Telegraph Co., Ltd., (of Copenhagen)	10	85-87
£58,700	100	4%	Halifax and Bermudas Cable Co., Ltd., 4% 1st Mort. Debs. Red.	100	100-102
17,000	25	12/6	Indo-European Tele. Co., Ltd.	25	50-52
72,680	1	7 <sup>1</sup> / <sub>4</sub> d.	Monte Video Telephone Co., Ltd., O.	1	2-2
£1,983,338	Stk	8%	National Telephone Co., Ltd., Pref.	100	108-109
£1,986,667	Stk	5%	Do. Deferred	100	101-108
250,000	5	2/6	Do. 5% Non-Cum. 3rd Pref.	5	54-52
£2,000,000	Stk	8%	Do. 8% Deb. Stk., Red.	100	100-102
£889,593	Stk	4%	Do. 4% do. do.	100	103-105
179,313	1	7 <sup>1</sup> / <sub>4</sub> d.	Oriental Telephone & Elec. Co., Ltd.	1	14-14
60,000	1	7 <sup>1</sup> / <sub>4</sub> d.	Do. 6% Cum. Pref.	1	17-17
£100,000	100	4%	Pacific & European Tel. 4% Guar. Debs. Red.	100	99-102
11,889	8	4/-	Reuter's Telegram Co., Ltd.	8	72-81
55,000	5	3/-	United River Plate Telep. Co., Ltd.	5	7-7
40,000	5	2/6	Do. 5% Cum. Pref.	5	6-6
£179,947	Stk	6%	Do. 5% Deb. Stock, Red.	100	107-109
15,609	10	4/-	W. African Telegraph Co., Ltd.	10	8-8
£80,008	24	—	West Coast of America, Ltd.	24	2-2
150,000	100	4%	Do. 4% Deb. Guar. by West. Tel.	100	100-102

## TELEGRAPHS AND TELEPHONES.—Contd.

Present Amount Subscribed.	Shares.	Last Dividend.	Name.	Paid up.	Closing Prices.
88,821	10	6d.	W. India & Panama Telep. Co., Ltd., Or.	10	14-14
84,563	10	6/-	Do. 6% Cum. 1st. Pref.	10	82-82
4,669	10	6/-	Do. 6% Cum. 2nd Pref.	10	8-8
£80,000	100	5%	Do. 5% Deb.	100	104-106
207,930	10	3/-	Western Telegraph Co., Ltd.	10	13-14
£75,000	100	5%	Do. 5% Debs., 2nd Series, 1906	100	101-103
518,945	Stk	4%	Do. 4% Deb. Stock, Red.	100	103-105

## VI.—SHIPPING COMPANIES.

Present Amount Subscribed.	Shares.	Last Dividend.	Name.	Paid up.	Closing Prices.
32,500	10	5/6	Anchor Line (Henderson Bros.), Ltd., 5% Cum. Pref.	10	8-9*
£825,000	Stk	4%	Do. 4% Red. 1st Mort. Deb. Stk.	100	98-100*
£672,900	Stk	4%	British & African Ste. Nav. (1900) Ltd., 4% 1st Mort. Deb. Stk., Red.	100	97-99
40,000	10	5/6	Bucknall Steamship Lines, Ltd., 5% Cum. Pref.	10	52-64
£600,000	Stk	4%	Do. 4% 1st Mort. Deb. Stk.	100	87-91
£750,000	Stk	4%	Clan Line Steamers, Ltd., 4% Deb. Stk. Red.	100	100-102
60,000	20	16/-	Cunard Steam Ship Co., Ltd., Nos. 1-60,000	20	113-124
40,000	20	8/-	Do. Nos. 60,001-100,000	10	42-54
£464,430	Stk	4%	Elder Dempster Shipping, Ltd., 4% 1st Mort. Deb. Stk.	100	99-101*
1,200,000	1	6d.	Furness, Withy & Co., Ltd., Ord.	1	14-14
25,328	7	4/7	Gen. Steam Navigation Co., Ltd., Ord.	7	5-5
36,758	8	4/9 <sup>3</sup> / <sub>4</sub>	Do. Non-Cum. 6% Pref.	8	8-8
£150,000	Stk	4%	Do. 4% 1st Mort. Deb. Stk. Red.	100	100-102
55,000	5	1/8	Houlder Line, Ltd., Ord.	5	22-23
40,000	5	2/9	Do. 5% Cum. Pref.	5	8-8
£200,000	Stk	4%	Do. 4% 1st Mt. Deb. Stk. Red.	100	87-89
141,500	10	5/-	Leyland (Fredk.), & Co., (1900), Ltd., 5% Cum. Pref.	10	42-5
£1,160,000	Stk	5%	Peninsular and Oriental Steam Nav. Co., 5% Cum. Pref.	100	132-136
£1,160,000	Stk	19%	Do. do. Deferred	100	229-232
15,000	100	30/-	Royal Mail Steam Packet Co. Ord.	60	29-30
89,075	5	2/6	Shaw, Savill & Albion, Ltd., 5% Cum. "A" Pref.	5	42-54*
39,075	5	2/6	Do. "B" Ord.	5	4-4
141,841	10	4/-	Union Castle Mail Steamship Co., Ltd., Ord.	10	82-83
24,000	10	4/6	Do. 4% Cum. Pref.	10	102-102
£1,008,894	Stk	4%	Do. 4% Debenture Stk., Red.	100	100-102

## VII.—MISCELLANEOUS COMPANIES.

Present Amount Subscribed.	Shares.	Last Dividend.	Name.	Paid up.	Closing Prices.
60,000	1	9 <sup>3</sup> / <sub>4</sub> d.	Chadburn's (Ship) Tele. Ltd., Ord.	1	17-17
£750,000	Stk	9%	General Hydraulic Power Co., Ltd.	100	128-133
12,500	10	10/-	Oakey (John) and Sons, Ltd., Ord.	10	24-26
10,000	10	6/-	Do. do. 6% Cum. Pf.	10	14-15*
188,588	1	6 <sup>3</sup> / <sub>4</sub> d.	Power Gas Corp., Ltd., Ord., Nos. 66,469-250	15/-	75-75
66,462	1	8 <sup>1</sup> / <sub>4</sub> d.	Do. do. Nos. 166,462	1	75-75
135,000	1	6d.	Waygood (R.) & Co., Ltd., Ord.	1	17-17
135,000	1	7 <sup>1</sup> / <sub>4</sub> d.	Do. 6% Cum. Pref.	1	18-18

## RAILWAY CARRIAGE &amp; WAGON COMPANIES.

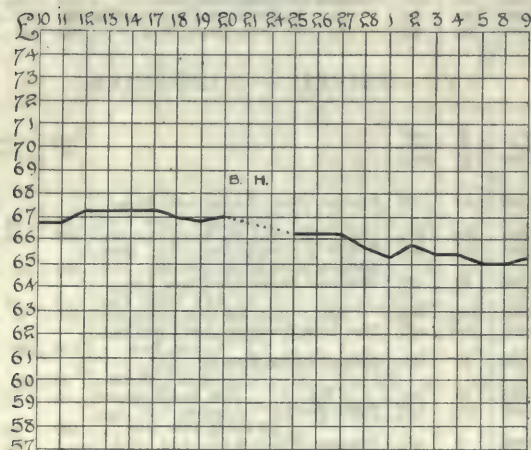
Present Amount Subscribed.	Shares.	Last Dividend.	Name.	Paid up.	Closing Prices.
10,000	10	7/6	Birm. Railway-Car. & Wagon, L.	10	22-23
8,739	10	3/-	Do. Second Issue 1-8,739	4	8-9
10,000	10	6/-	Do. Cum. Pref. 6% 1-10,000	10	13-14
80,111	7	7/-	Gloucester Rail.-Car & Wagon, Ltd., A. 1-39,861 & 49,751-60,000	7	9-9
44,889	7	3/6	Do. B. 29,862-49,750, 50,001-75,000	7	4-4
14,567	10	1/8	Lancashire Wagon, Ord.	2	2-2
4,150	10	5 <sup>1</sup> / <sub>4</sub> d.	Do. do.	10	104-104
781,908	1	9d.	Metropolitan Amalgamated Rail. Carriage & Wagon, Ltd., 1-784,908	1	43/-44/-
164,288	1	6d.	Do. Cum. A Pref. 6% 1-164,288	1	24/-25/-
235,000	1	7 <sup>1</sup> / <sub>4</sub> d.	Do. Cum. B Pref. 6% 1-235,000	1	28/-29/-
20,000	20	20/-	Midland Rail.-Car. & Wagon, L., 1-20,000	10	19-19



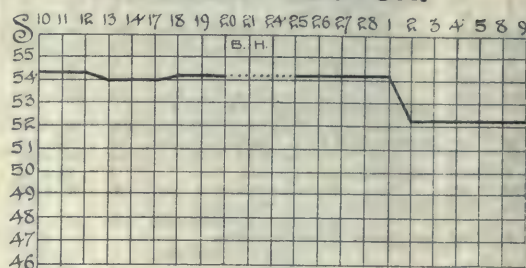
# THE HOME METAL MARKET.

SHOWING DAILY FLUCTUATIONS FROM APRIL 10TH TO MAY 9TH, 1905.

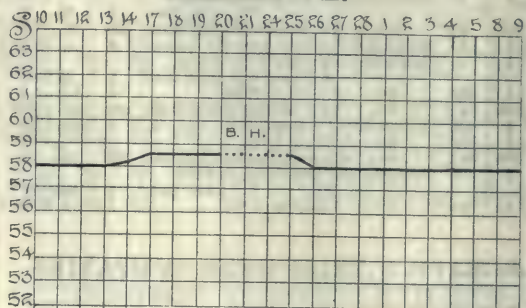
## COPPER.



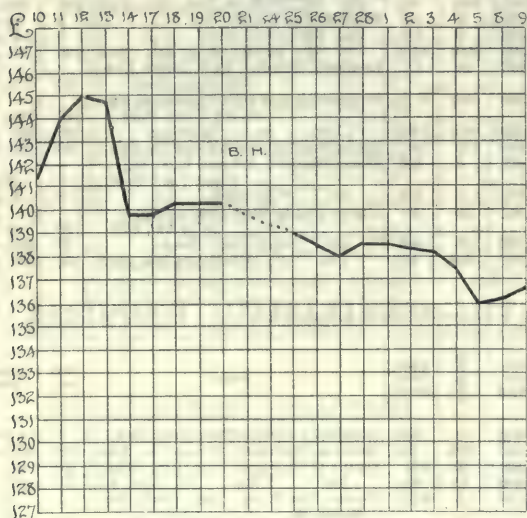
## PIG IRON: SCOTCH.



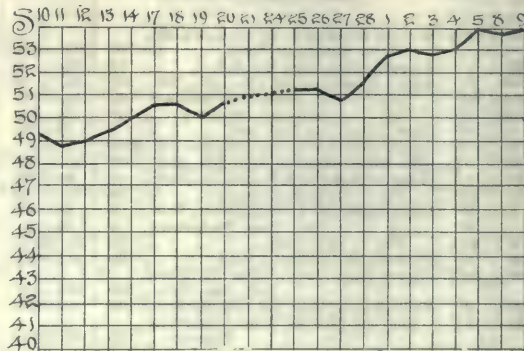
## HEMATITE.



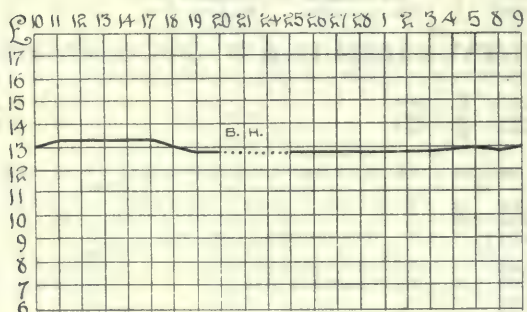
## TIN.



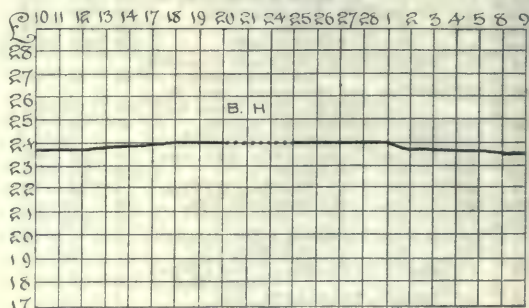
## CLEVELAND.



## ENGLISH LEAD.



## SPELTER.





# PRICES CURRENT OF COAL, IRON, STEEL, AND OTHER METALS.

## MANUFACTURERS' AND MERCHANTS' QUOTATIONS.

### MARKET REPORT.

Wednesday, May 10th, 1905.

THE key to the Copper market has been the position in Wall Street, the metal having been dominated by the fluctuations in copper shares. Hence the fall in New York brought a good deal of Copper upon the market and prices receded to £65. The latest tendency shows a better tone, the closing prices yesterday being £65 6s. 3d. cash and £65 10s. three months.

In the tin market a stronger tone is in evidence. The shrinkage in reserves continues, but it happens that London holds an even larger proportion than usual, tin having been attracted by the locking up of cash warrants here. There has been some demand for early shipment on American account, and a moderate amount of business has been done for the East, at prices generally over London parity. Owing to the smallness of existing stocks the market is very sensitive at the present level, but the latest prices are firm at £136 12s. 6d. cash, and £134 7s. 6d. three months.

The Lead market has hardened somewhat in response to a better trading demand, and prices are slightly higher at £12 13s. 9d. foreign, and £13 English.

In the Spelter market on a good demand from galvanisers an attempt was made to put quotations higher, but some heavy bear selling for forward delivery caused a sharp break in quotations to £23 10s. The quantities on offer were fairly well absorbed however, and some recovery in quotations is to be recorded, although prices as compared with last week are lower on balance.

In the Iron and Steel market the attempt to squeeze the bears has been temporarily successful, the price for Cleveland cash warrants having been forced up to 54s. 1½d. The position as elsewhere explained is somewhat complicated, but the market daily becomes more congested, and as outside holders have realised to the full extent, the clique have the market to themselves, and very little iron changes hands. The abnormal position combined with the dull tone in almost all classes of manufactured iron and steel is reducing business to a minimum.

### IRON, STEEL, PIG- IRON, &c.

#### SCOTLAND.

Messrs. David Colville and Sons, Ltd., Dalzell Steel and Iron Works, Motherwell, N.B., quote as follows. Prices delivered in Glasgow or equal:—

Steel:		£	s.	d.
DALZELL	Siemens' Steel Plates, Marine Boiler Quality	6	15	0
STEEL	" " " " Land	6	17	6
STEEL	" " Steel Bars, Boiler Quality	6	17	6
DALZELL	Siemens' Steel Plates, Ship Quality Plates	5	17	6
STEEL	" " " " Bars	6	7	6
STEEL	" " " " Angles	5	7	6

#### Manufactured Iron:

Bars—Dalzell	6	2	6
" Best	6	12	6
" " Horseshoe	6	12	6
" Angle	6	2	6
" Best Angle	6	12	6
" Best Best	7	2	6
" Extra Best	7	12	6

Usual terms and extras. Special rates for delivery in England and export. The above prices subject to alteration without notice.

The Glasgow Iron and Steel Co., Ltd., Wishaw, quote as under (prices are delivered Glasgow or equal):—

	£	s.	d.	
Steel Angles (Glasgow  Steel)	5	7	6	per ton.
Steel Ship Plates (Glasgow  Steel)	5	17	6	"
Steel Bars, Ship Quality (Glasgow  Steel)	6	7	6	"
Steel Bars, Boiler Quality (Glasgow   Steel)	6	17	6	"
Steel Land Boiler Plates (Glasgow   Steel)	6	7	6	"
Steel Marine Boiler Plates (Glasgow   Steel)	6	7	6	"

Less 5 per cent. discount. Extras as per standard list.

Special prices for delivery in England and for export. The above prices subject to alteration without notice.

John Spencer (Coatbridge), Ltd., Phoenix Iron-works, Coatbridge, N.B., quote:—

Bars—Phoenix	£	s.	d.
" Best	6	5	0
" Best Best	7	5	0
" Extra Best	7	15	0
" Best Horse Shoe	6	15	0
" Extra B.H.S.	7	15	0
" Extra Best Cable	8	5	0
" Rivet	6	5	0
" Best Scrap Rivet	7	5	0



<b>Angles—Phoenix</b> .....	£ s. d.
„ Best .....	6 5 0
„ Extra Best .....	7 5 0
<b>Gas Tube Hoops—Phoenix Best</b> .....	6 15 0
<b>Plates—Phoenix</b> .....	—
„ Best Boiler .....	7 10 0
„ Best Best Boiler .....	8 0 0
„ Extra Best Boiler .....	9 0 0
<b>Boiler Tube Strips—Phoenix Best Best</b> .....	8 0 0


All per ton, delivered f.a.s., Glasgow, Greenock, Grangemouth, Granton, Leith, or Ardrossan. 5 per cent. discount cash monthly.

**Messrs. R. Feldtmann and Co., of Glasgow,** quote Commission extra).

<b>Pig Iron :</b>	No. 1.	No. 3.
	£ s. d.	£ s. d.
Coltness, f.a.s. Glasgow .....	3 4 6	2 14 0
Gartsherrie .....	2 19 0	2 14 0
Summerlee .....	2 19 0	2 14 0
Carnbroe .....	2 16 6	2 12 6
Langloan .....	3 4 0	2 15 0
Calder .....	2 19 0	—
Clyde .....	2 18 6	2 13 6
Glegarnock, f.o.b. Ardrossan .....	2 18 0	2 12 6
Eglinton .....	2 14 6	2 12 6
Dalmellington, „ Ayr .....	2 14 6	2 12 6
Shotts .....	2 19 0	2 14 6

### NORTH OF ENGLAND.




**Messrs. W. Whitwell and Co., Ltd., Thornaby Ironworks, Stockton,** quote as follows, at works:—

	£ s. d.
W.W.  Bars .....	6 12 6
W.W. Best Bars .....	7 2 6
W.W. Best Best .....	7 12 6
W.W. Best Best Best .....	8 2 6
W.W. Best Shoe .....	7 2 6
Thornaby  .....	8 2 6
Thornaby Best .....	8 12 6
Thornaby Best Best .....	9 12 6
Whitwell Special Admiralty Cable .....	10 5 0
Special Chain Iron .....	9 5 0
Tube and Nail Strips .....	6 15 0
W.W.  Angle Iron .....	6 15 0
W.W. Best Angle Iron .....	7 5 0
Tee Iron, to 8-inches United .....	7 12 6

Terms, Cash, less 2½ per cent. discount on 10th of month following delivery.

### LANCASHIRE.

**The Pearson and Knowles Coal and Iron Company, Ltd. Dallam and Bewsey Forges, Warrington,** quote:—

	Iron.	Steel.
	£ s. d.	£ s. d.
 Bars .....	6 10 0	6 15 0
(BF)  Angles .....	7 0 0	7 5 0
„ Tees .....	7 10 0	7 15 0
 Hoops .....	7 0 0	7 10 0
W.I.W. Sheets .....	7 10 0	8 0 0

Ordinary Sizes, F.A.S. Liverpool in 10-ton Lots.  
Extras for Sizes and Cutting as per List.

### WORCESTERSHIRE.

**Baldwins Ltd. (with which is amalgamated Knight and Crowther, Ltd.), Wilden Works, near Stourport,** quote:—

	Singles 20 G 36in. by 36in. per ton.	Doubles 21 G to 24 G 36in. by 36in. per ton.
<b>Black Sheets :</b>	£ s. d.	£ s. d.
„ Vale .....	10 0 0	10 10 0
„ Shield .....	10 10 0	11 10 0
„ Severn .....	11 10 0	12 10 0
„ Baldwin Wilden B. .....	12 10 0	13 10 0
Charcoal .....	16 10 0	17 10 0
Best Charcoal .....	18 10 0	19 10 0

Pickled, cold-rolled and close annealed sheets specially quoted for.

Extra widths, Singles to 66in., Doubles to 56in., Lattens to 46in. Extra lengths, Singles to 168in., Doubles to 132in., Lattens to 108in.

### Patent Coated Sheets:

	£ s. d.	£ s. d.
No. 3 Lead .....	13 10 0	14 10 0
S.V. Lead .....	15 0 0	16 0 0
No. 3 Terne .....	15 0 0	16 0 0
S.V. Terne .....	16 10 0	17 10 0

	Singles 20 G to 108 by 36in. per ton.	Doubles 21 to 24 G to 96 by 36in. per ton.
<b>Tinned Sheets :</b>	£ s. d.	£ s. d.
Best Coke (Finish) .....	29 0 0	30 10 0
„ Charcoal (Finish) .....	31 0 0	32 10 0
Extra „ „ .....	33 0 0	34 10 0

Cotton Can Tin Sheets to 39in. by 36in. specially quoted for.  
Tin Plates, „Cookley, K” Best Charcoal, £1.7s. 0d. per box.  
Extreme sizes in Tin and Patent Coated specially quoted for.  
Lattens up to 36 wide by 27 W.G. £1 10s. 0d. per ton extra throughout for all brands.  
At works.

### Galvanized Corrugated Sheets :

	£ s. d.
„ Phoenix” Brand, 24 G., f.o.b. London, in Bundles .....	11 12 6 per ton.
„ Blackwall” Brand, 26 G., in felt-lined cases for Australia, f.o.b. London .....	14 5 0 „

### Galvanized Working Up-Sheets :

	£ s. d.
24 G., f.o.b. London, in Bundles .....	13 12 6 per ton.

### STAFFORDSHIRE.

**Shelton Iron, Steel, and Coal Co., Ltd., Stoke-on-Trent, North Staffordshire, and 122, Cannon Street, London,** quote:—

	£ s. d.
Crown Bars .....	6 10 0 per ton.
Best Bars (1 to 6in. wide, above ½ in. thick, ½ in. to 4 rounds and squares) .....	7 0 0 „
Angles .....	6 15 0 „
„ Best .....	7 5 0 „
T's .....	7 0 0 „
„ Best .....	7 10 0 „
Best Shoe Iron .....	8 0 0 „
„ Rivet Iron .....	8 0 0 „
„ Best Rivet (Special) .....	9 5 0 „
„ Cable .....	9 5 0 „
„ Screwing .....	8 5 0 „



	£	s.	d.	
Best Turning .....	8	0	0	per ton.
„ Plating .....	8	5	0	„
Best Best .....	9	5	0	„
Treble Best .....	10	5	0	„
Plates .....	7	10	0	„
Best Plates .....	8	0	0	„
„ Boiler Plates .....	8	10	0	„
„ Best Boiler Plates .....	9	10	0	„
Treble Best Boiler Plates .....	12	0	0	„

Delivery f.o.b. Liverpool, Birkenhead or Manchester.

### WALES.

**Cordes (Dos Works), Ltd., of Newport, Mon.,**  
quote "Star" brand patent wrought nails, steel nails, &c.

### Discounts—

45 per cent. off 1-inch to 3-inch strong rose and all fine rose and 8dy. and 8dy. pound.

40 per cent. off 3½-inch to 7-inch strong rose and 10dy. and 20dy. pound.

40 per cent. off all sharp-pointed nails.

Delivered in lots of 4 cwt. and upwards. Extra 2½ per cent. discount off the gross on two tons and upwards.

Steel rose, flat points, 5-inch to 7-inch basis:—

2 tons 9/6 per cwt. } d/d any Railway Station.  
4 cwt. lots and upwards 9/9 per cwt.

Steel cut nails, 3-inch basis—

2 tons 8/3 per cwt. } d/d any Railway Station.  
4 cwt. lots 8/6 per cwt.

Slit rods (iron) £7 10s. per ton, at works for 2-ton lots.

**Messrs. Richard Thomas and Co., Ltd., of**  
**33 and 35, Eastcheap, E. C. — Works: South**  
**Wales, Burry, Lydney, Lydbrook, and Cwmbwrla,**  
quote:—

	Per Box.	
	f.o.b.	
	Wales.	
	£	s. d.
Coke Tin-plates.		
C 18½ by 14 124s. 110 lb. "BV"	0	12 3
C 20 by 10 225s. 155 „ "Jumbo"	0	17 3
C 20 by 14 112s. 108 „ "Lydbrook"	0	11 10½
C 28 by 20 112s. 216 „ "Lydbrook"	1	4 0

### Charcoal Tinplates:

C 20 by 14 112s. 108 lb. "Allaway"	0	12 7½
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### BELGIUM.

**C. L. Faulkner, Suffolk House, Laurence**  
**Pountney Hill, London, E.C., quotes:—**

Prices quoted are in £ stg. and per ton of 1,015 kos. (2,240 lb.) delivered free on board ANTWERP for approved quantities.

Steel:	£	s.	d.	
Blooms .....	at	3	16	0 per ton.
Billets .....	at	3	18	0 „
Sheet Bars .....	at	4	0	0 „

### Finished Steel:

Bars .....	at	5	2	0 per ton.
Angles .....	at	5	3	0 „
Tees .....	at	5	6	0 „
Joists .....	at	4	10	0 „
Fencing Standards .....	at	5	3	8 „
Shoeing Bars .....	at	5	5	0 „
Tyre Bars .....	at	5	5	0 „
Half-Round Bars .....	at	5	10	0 „
Heavy Rails .....	at	5	5	0 „
Light Rails .....	at	4	17	8 „

### Structural Steelwork:

Prices on application.

## METALS.

**Messrs. French and Smith, 147, Leadenhall**  
**Street, and 11, Oldhall Street, Liverpool, quote:—**

### TIN.

Tin:	£	s.	d.	£	s.	d.	
English Ingots, f.o.b. ....	136	0	0	to	136	10	0 per ton.
Dis. 1½% & 1% .....	137	0	0	to	137	10	0 „
English Bars, f.o.b. ....	136	10	0	to	136	12	6 „
Dis. 1½% & 1% .....	134	5	0	to	134	7	6 „
Straits G.M.B., cash	136	10	0	to	137	0	0 „
Warehouse, Net .....	134	5	0	to	134	7	6 „
Straits G.M.B., 3 months,	136	10	0	to	137	0	0 „
Warehouse, Net .....							
Australian, Mt. Bischoff,							
Warehouse, Net .....							

### COPPER.

Copper:	£	s.	d.	£	s.	d.	
Standard G.M.B., cash	65	5	0	to	65	6	3 per ton.
Warehouse, Net .....	65	10	0	to	65	11	3 „
Standard G.M.B., 3							
months, Warehouse,							
Net .....	69	0	0	to	69	10	0 „
English, Tough, Cake &							
Ingots, Warehouses,							
Net .....	70	0	0	to	70	10	0 „
English, Best Select,							
Warehouse Net .....	79	0	0	to	80	0	0 „
English, Sheets and							
Sheathing, f.o.b., Dis.							
2½% .....	76	0	0	to	76	10	0 „
English Sheets for India,							
f.o.b., Dis. 2½% .....	70	15	0	to	71	0	0 „
Electro, Warehouse, Net ..	0	12	1½	to	0	13	1½ per unit.
Ore, ex ship .....	0	13	4½	to	0	13	10½ „
Regulus, Matte and							
Precipitate, ex ship, .....							

### YELLOW METAL.

Yellow Metal:	£	s.	d.	
Sheets, 4 by 4 feet for				
India f.o.b. Dis. 2½% .....	0	0	6½ per lb.	
Sheathing „ „ .....	0	0	6½ „	

### SPELTER.

	£	s.	d.	£	s.	d.	
Silesian outports, Net .....	23	10	0	to	23	15	0 per ton.
Blende of 50 % Net .....	6	9	6	to	6	12	6 „
Calamine, Net .....	6	12	0	to	6	14	0 „

### LEAD.

	£	s.	d.	£	s.	d.	
English Pig, Warehouse,							
Dis. 2½% .....	12	17	6	to	13	0	0 per ton.
Spanish, ex ship, Dis. 2½% ..	12	13	9	to	12	15	0 „
Lead Ore of 70 %, Net .....	6	9	0				

### ANTIMONY.

	£	s.	d.	£	s.	d.	
Star Regulus, f.o.b., Dis.	36	0	0	to	37	0	0 per ton.
2½% .....	9	10	0	to	10	10	0 „
Ore, 50 %, ex ship, Dis. 2½% ..	14	0	0	to	16	0	0 „
Crude, ex ship, Dis. 2½% .....							

### QUICKSILVER.

	£	s.	d.	
Spanish, 75 lb., Warehouse, Net .....	7	7	6 per flask.	
Italian „ „ „ .....	7	5	0 „	



**COAL.****LEICESTERSHIRE.**

**The Nailstone Colliery Company, Leicester,**  
quote. Price per Ton at Pit of 20 Cwt., with  $\frac{1}{2}$  Cwt. per  
Ton for wastage —

Upper Main Seam.		s. d.
Main Coal		7 0
Best Hard Steam (hand picked, as used by the Railway Companies)		5 6
Best Hard Steam Cobbles (made through 6 in. mesh, free from slack)		5 6
Fine Slack		0 6

Terms, net cash on 10th of month following delivery.

**DERBYSHIRE.**

**The Manners Colliery Co., Ltd., of Ilkeston**  
quote as follows, per ton at pit:

Kilburn Coal:		s. d.
Best London Brights		9 9
Large Nuts ( $1\frac{1}{2}$ to $2\frac{1}{2}$ )		9 6
Small Nuts ( $\frac{3}{4}$ to $1\frac{1}{2}$ )		6 0
Rough Brights		6 0
Peas ( $\frac{3}{4}$ to $\frac{3}{2}$ )		5 0
Slack		3 6
Smudge		2 0

**Low Main (or Tupton) Coal:**

Low Main Brights	7 6
" Nuts	7 3
Hards (Good Steam Coal)	8 0
Bakers' Nuts (1" to 2")	6 6
Slack	3 6

**The Clay Cross Company's Collieries, Clay Cross,**  
near Chesterfield, quote:—

	per ton at pit.
	s. d.
Best Main Coal	10 6
Best Silkstone	10 0
Best House Coal	8 6
Best House Nuts	8 0
Treble Screened Cobbles	7 9
Best Cobbles	7 3.

**NOTTINGHAMSHIRE.**

**The Digby Colliery Co., Ltd., near Nottingham,**  
quote per ton at pit:—

**Digby Coal:**

STEAM.		s. d.
Best Hand Picked Hard		8 6
Steam Hard		7 3
Hard Nuts		6 6

**Gedding Colliery.****HIGH HAZEL.**

London Brights, 4 to 8 in. cube	10 6
Large Nuts, 2 to 4 in. cube	8 6
Small Nuts, 1 to 2 in. cube	6 0
Pea Nuts, $\frac{3}{4}$ to 1 in. cube	5 0

**STEAM.—TOP HARD.**

Best Hard	8 6
Hard Steam	7 6
Cobbles	6 6

**CHEMICALS.**

**Messrs. S. W. Royse and Co., Albert Square,**  
Manchester, quote:

	£	s.	d.
Acids: Oxalic	0	0	2 $\frac{1}{2}$ per lb.
Picric, Crystals	0	0	11 "
Tartaric	0	0	10 $\frac{1}{2}$ "

	£	s.	d.
Acetate of Lime: Brown at Manchester net	9	15	0 per ton.
Grey	12	0	0 "
Alumina: Alum, Lump, loose	5	5	0 "
" " in casks	5	7	6 "
" " Ground, in bags	5	15	0 "
Sulphate of Alumina, 14%	4	10	0 "

Ammonia: Carbonate	0	0	3 $\frac{1}{2}$ per lb.
Muriate Grey f.o.b. Liverpool	23	15	0 per ton.
Sal-ammoniac, Lump, 1sts, del <sup>d</sup> U.K.	42	0	0 "
" " 2nds	40	0	0 "
Sulphate " f.o.b. Liverpool	12	12	6 "
Arsenic: Best White Powdered	12	5	0 "
Bleaching Powder, 35%	4	10	0 "
Borax: British Refined Crystal	12	0	0 "

**Coal Tar Products:**

Benzole, 50/90 %	0	0	8 per gal.
" " 90%	0	0	7 "
Carbolic Acid Crystals, 34/35° C.	0	0	6 per lb.
" " 39/40° C.	0	0	6 $\frac{1}{2}$ "
" " Liquid, 97/99 %	0	0	9 per gal.
" " Crude, 62 $\frac{1}{2}$ % at 60° F.			
" " f.o.b.	0	1	9 $\frac{1}{2}$ "
Creosote, ordinary good liquid	0	0	1 $\frac{1}{2}$ "
Naphtha, Crude, 20 % at 120° C.	0	0	8 "
" " Solvent, 90 % at 160° C. f.o.b.	0	0	8 "
" " 95 % at 160° C.	0	0	9 "
" " 90 % at 190° C.	0	0	10 "
" " Rectified, flash point over 73° F.	0	0	11 "
" " Rectified, flash point over 100° F.	0	1	0 "

Naphthalene, all qualities.

Pitch	1	9	0 per ton.
Copperas: Green, in bulk	0	12	6 "
" " barrels f.o.b. L'pool	1	19	0 "
" " Cake	1	2	6 "
Copper: Sulphate	21	17	6 "

**Cyanides: 98% minimum** f.o.b. net 0 0 7 $\frac{1}{2}$  per lb.

Lead: Acetate (Sugar) White, English	27	10	0 per ton.
" " Foreign c.i.f. U.K.	23	5	0 "
" " Grey	21	15	0 "
" " Brown at Manchester	16	15	0 "
Nitrate	24	0	0 "
Litharge, Flake	15	10	0 "
" " Powder	16	0	0 "
Red Lead, Genuine, c.i.f. London			
less 5%	15	10	0 "
White " " Dry " "	16	15	0 "

**Naphtha (Wood): Miscible, 60 o.p.** 0 2 10 per gal.  
Solvent.. 0 2 7 "

Potash: Bichromate... delivered England	0	0	3 per lb.
Carbonate, 90/92 % ... c.i.f. Hull	18	5	0 per ton.
Caustic, 75/80 %	20	10	0 "
Chlorate	0	0	3 $\frac{1}{2}$ per lb.
Montreal... in Store, Liverpool	34	0	0 per ton.
russiate, Yellow	0	0	5 per lb.



	£	s.	d.	
Soda: Ash, Caustic, 48 %, Ordinary .. net	5	5	0	per ton.
" " " " Refined .. "	6	5	0	"
" " Carbonated, 48 % .. "	5	10	0	"
" " " 58 % (Ammonia .. net	4	10	0	"
" " Bleachers' Refined Caustic .. net	6	10	0	"
" " 50/52 % .. "	10	10	0	"
Caustic, White, 77 % .. "	9	12	6	"
" " 70 % .. "	8	12	6	"
" " 60 % .. "	8	10	0	"
" " Cream, 60 % .. "	3	0	0	"
Crystals, in bags .. "	3	7	6	"
" " barrels .. "	16	15	0	"
Acetate .. c.i.f. Hull net	6	15	0	"
Bicarbonate, in 1 cwt. kegs. ....	0	0	2½	per lb.
Bichromate .. delivered England ..	0	0	3½	per lb.
Chlorate .. net	11	5	0	per ton.
Nitrate .. ex quay Liverpool, ..	9	5	0	"
Phosphate .. net	0	0	3½	per lb.
Prussiate .. net	4	10	0	per ton.
Silicate, Solution, 140° Tw. ....	1	12	6	"
Sulphate (Glauber Salts) .. "	1	15	0	"
" (Saltcake, 95%) .. "	4	15	0	"
Sulphur: Recovered .. "	6	15	0	"
" Roll .. "	7	10	0	"
" Flowers .. "	6	15	0	"
Zinc: Sulphate .. "	7	5	0	per cwt.
Shellac: Standard TN orange spot ..				

## MINERALS.

Messrs. S. W. Royse and Co., quote:—

	£	s.	d.	
Barytes: Lump Carbonate, 90/92% ..	3	10	0	per ton.
" Sulphate, No. 1, White ..	2	15	0	"
China Clay: of various qualities for all purposes; prices from about 11/- to about 30/- per ton, f.o.b. Cornwall: stocks also kept at Runcorn and Preston. Quotations given carriage paid.				
Chrome Ore: Basis 50% c.i.f. British Ports ..	3	7	6	"
Manganese: Lump c.i.f. Liverpool 10½d. per metallic unit.				
Ochre: French JC .. f.o.b. Rouen, net	2	5	0	per ton.
" " JF ..	5	10	0	"
Talc: (French Chalk) .. c.i.f. Liverpool	3	10	0	"

Messrs. Henry Bath and Son, quote:—

	£	s.	d.	£	s.	d.	
Copper, Ores of, 10 to 25% ..	0	12	0	to	0	13	0 per unit.
" Regulus, 45 to 55% ..	0	13	3	to	0	13	9 "
" Precipitate, 65 to 80% ..	0	13	4½	to	0	13	10½ "
Tin Ores, 70 % ..	86	0	0	to	88	0	0 per ton.
Lead Ore, 70% ..	6	8	0				"
Blende, 50% ..	6	11	6				"
Calamine ..	6	14	0				"
Antimony Ore, 50% ..	9	0	0	to	10	0	0 "

Messrs. Barrington and Holt, Cartagena, quote:—

Iron Ore.

	s.	d.	
Ord. 50%, .. f.o.b. Porman ..	6	4	per ton.
" Do. .. Cartagena ..	6	7	"
Special low phos. .. Porman ..	7	0	"
" Do. do. .. Cartagena ..	7	3	"
Extra quality do. ..	7	8	"
Special Iron Ore ..	8	4	"
Specular 58% do. ..	9	4	"

## TIMBER.

Messrs. Alfred Dobell and Co., Liverpool, quote:—

### COLONIAL WOODS.

#### Timber.

	£	s.	d.	£	s.	d.	
Quebec Square White Pine... per cub. ft.	0	1	9	to	0	3	3
Quebec Waney Board Pine...	0	2	8		0	3	9
St. John Pine, 18 in. average ..	0	2	4		0	3	3
Lower Ports Pine .....	0	1	3		0	1	8
Quebec Red Pine .....	0	1	6		0	2	3
Quebec Oak, 1st quality .....	0	2	9		0	3	4
Quebec Oak, 2nd quality ...	0	1	6		0	2	6
Ash .....	0	1	6		0	2	3
Elm .....	0	3	3		0	4	0
Hickory .....	0	2	0		0	2	6
Quebec Birch .....	0	1	6		0	2	3
St. John Birch .....	0	1	6		0	2	0
Birch Planks .....	0	0	9		0	0	11
Spruce Spars .....	0	0	10		0	1	0

#### Deals.

1st quality Quebec Pine .. per std.	22	10	0	to	32	10	0
2nd do. do. ..	17	0	0		22	0	0
3rd do. do. ..	11	10	0		13	0	0
St. John, N.B., etc., Spruce ..	7	10	0		7	15	0
Nova Scotia Spruce ..	7	0	0		7	10	0

Spruce Boards ..	6	7	6		6	12	6
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### UNITED STATES, etc., WOODS.

#### Pitch Pine.

	£	s.	d.	£	s.	d.
Hewn .....	per cub. ft.	0	1 4	to	0	1 8
Sawn .....	"	0	1 0		0	1 6
Planks, Stowage .....	"	0	0 10		0	1 0
Boards, Prime .....	per std.	12	10 0		16	0 0

Oak Timber .. per cub. ft.	0	1	6		0	2	6
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Oak Planks ..	0	1	6		0	2	1
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East India Teak .. per load	12	0	0		16	0	0
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Greenheart ..	6	15	0		7	10	0
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### EUROPEAN WOODS.

#### Timber.

	£	s.	d.	£	s.	d.	
Riga Redwood ..... per cub. ft.	0	1	6	to	0	2	0
Dantzic and Memel Fir, Crown .....	0	2	1		0	2	6
Dantzic and Memel Fir, Middling .....	0	1	9		0	1	11
Stettin .....	0	1	9		0	1	11
Swedish .....	0	1	0		0	1	3
Riga Whitewood .....	0	1	0		0	1	3
Norway Mining Timber .....	0	0	9		0	1	0
Dantzic and Stettin, etc., Oak .....	0	2	6		0	3	0

Norway Spars ..	0	1	2		0	1	9
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#### Deals.

Red Archangel and Onega, 1st quality .. per std	19	0	0		20	0	0
Red Archangel and Onega, 2nd quality ..	14	0	0		16	0	0
Red Archangel and Onega, 3rd quality ..	10	10	0		12	10	0
St. Petersburg, 1st quality ..	16	0	0		17	10	0
" Do. 2nd ..	14	0	0		15	0	0
Gefle ..	11	10	0		16	0	0
Wyburg ..	11	0	0		12	10	0
Uleaborg ..	10	0	0		12	10	0
Gothenburg ..	11	0	0		16	0	0



## SELECTED PATENTS.

Compiled expressly for this journal by **Messrs. Page and Rowlingson, Engineering Patent Agents, 28, New Bridge Street, London, E.C.,** and at Manchester.

*Copies of Specifications may be obtained at the Patent Office Sale Branch, 25, Southampton Buildings, Chancery Lane, W.C., at the uniform price of 8d.*

### NEW PATENTS APPLIED FOR.

When Patents have been communicated the names of the communicators are printed in *italics*.

**2851a. Fried. Krupp Akt.-Ges., London.** April 25th.—Improvements in cooling crank pins and shafts.

**8568. A. Macdonald, Glasgow.** April 25th.—Improvements in and relating to machines for grinding, turning, and finishing shafts, rods, pins, tool and other mechanical work.

**8671. J. Martin, Guisboro'.** April 25th.—Motor wheel motive power—steam, gas, water, and petroleum.

**8672. R. Smith, Edinburgh.** April 25th.—A drain "faultfinder" for detection of faults in the inside of drainage or other pipes.

**8673. W. Moore, Rochdale.** April 25th.—Rotary feeder.

**8675. L. Wilson, Greenock.** April 25th.—Improvements in the methods of constructing turbine blades.

**8686. F. W. Walker and T. Scott, Leices-ter.** April 25th.—Improvements in change speed and reversing gears.

**8694. W. Fee, Lincoln.** April 25th.—An improved lock, nut and bolt.

**8701. J. B. Hannay, London.** April 25th.—Improvements in and relating to change-speed gears.

**8702. P. J. Dicker and J. H. Dicker, London.** April 25th.—Improvements in and relating to forced feed lubrication.

**8707. F. W. Kent, London.** April 25th.—Footrest swing crank.

**8708. A. L. M. Royé, London.** April 25th.—Improvements in and relating to fire tubes. (Date applied for April 27th, 1904.)

**8727. C. H. Bardenwerper, C. S. Matteson, J. E. Matteson, and G. W. Burr, Liver-  
pool.** April 25th.—Improvements in rotary motors, pumps, and the like.

**8752. M. Munzesheimer, London.** April 25th.—Improvements in edge-runners.

**8758. L. C. Reese, London.** April 26th.—Improvements in Perkin's steam-heating tubes.

**8781. F. Niblock, Wallasey.** April 26th.—A combined feed-water heater and heat circulator for steam cylindrical boilers.

**8782. A. Gosling, Manchester.** April 26th.—A new or improved turbine.

**8783. D. Stewart and Co., Ltd., and J. B. T. Crosbie, London.** April 26th.—Improvements in spark arresters for funnels of steam-motor wagons.

**8790. F. L. Robinson, London.** April 26th.—An improved relief valve for locomotive cylinders and the like. (Date applied for April 28th, 1904.)

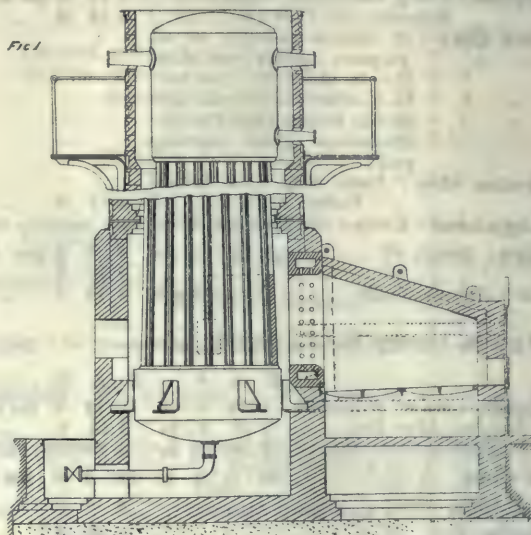
**8796. H. H. Lake, London.** April 26th.—Improvements in gas engines. (*American Rotary Engine Co., U.S.A.*)

**8802. J. S. Walker, T. A. Walker and E. R. Walker, Liverpool.** April 26th.—Improvements in or in connection with lubricating valves.

### RECENT SPECIFICATIONS.

#### IMPROVEMENTS IN FURNACES FOR WATER-TUBE AND OTHER STEAM BOILERS.

**Messrs. H. and T. Danks, Ltd., Netherton, Staffs.** April 6th, 1905.—This invention relates to improvements in furnaces for water-tube and other boilers, and has for its object a means whereby the admission of cold air through the furnaces during stoking and clearing, with consequent chilling of the tubes, is materially reduced, and in some cases completely obviated, thus



avoiding undue expansion and contraction in the tubes as well as obviating much of the necessity for the use of mechanical stokers, rocking bars, and other such contrivances. The variation of temperature upon certain parts of the tubes is reduced, while at the same time the higher temperature is more constantly maintained. In carrying this invention into effect, as applied to a water-tube boiler, the one boiler is provided with two separate and distinct furnaces, which are adjacent to each other, each being connected with the boiler and having grate bars, external doors, and bridges between the furnaces

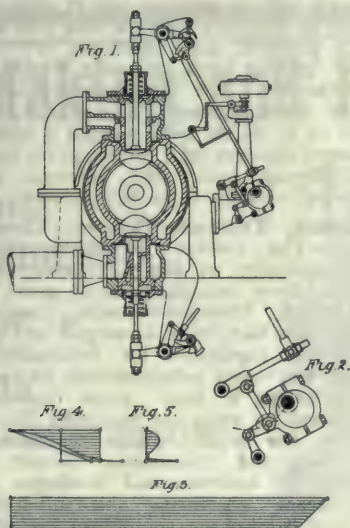


and the interior of the boiler, thus rendering it possible to stoke the furnaces alternately. Each furnace may have a damper, arranged at or near each bridge, by which means the furnace, which is being stoked can be practically shut off from the boiler during the period of stoking, thus preventing the passage through of the cold air, and at the same time, without any interference with the working of the other furnace. Each of the bridges is hollow in construction, with perforations arranged in such a position as to cause the air and heated gases to impinge upon the uncombusted gases as they pass over and through the bridges, the interior of which is connected by flues passing through the sides of the furnace and terminating with an inlet at the front near the furnace doors, which inlet is so arranged as to be capable of adjustment, while a series of deflecting blocks may be arranged opposite the inlets to the boiler to prevent the direct impingement of the heat upon the tubes at those points. The furnace roofs and passages leading to boiler are lined with firebrick, fireclay, or other such material, so that upon becoming heated they assist in igniting the uncombusted gases.

### IMPROVEMENTS IN VALVE-GEARING FOR STEAM, GAS, PETROLEUM, AND LIKE ENGINES.

**Wilhelm Hartmann, of Berlin, Germany.**  
April 6th, 1905.—The subject of this invention is a positive valve gear for steam, gas, petroleum, and like engines.

Fig. 1 of the drawings shows, by way of example, a constructional form of the improved valve gear suitable for use with a gas engine. The admission or inlet valve and the exhaust valve are driven by sets of gearing, either directly as shown, or through connecting rods or linkwork. These sets of driving gear can be themselves driven from the valve-actuating shaft by means of cranks or eccentrics, or by the aid of inter-



mediate mechanism, as is shown for the admission valve. In order to balance the effect of the inertia of the valves caused by the acceleration, the valve-gearing can be combined with spring mechanism, that is to say, with arrangements for storing up and giving out energy. Both forms of gearing can be employed for admission as well as for exhaust. They consist of a lever which has a surface for rolling on another lever, and which is called

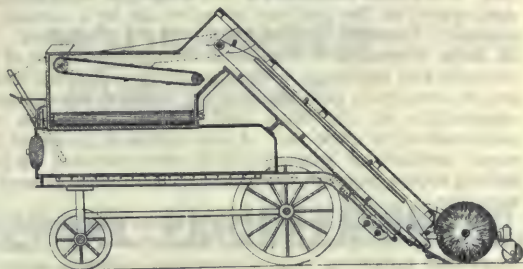
a roller-lever, a link, a connecting lever with two claw-shaped projections, a roller-lever with claws and with a tooth or projection, and a detent, the part being connected to the valve-spindle, as shown in fig. 1.

The main advantages claimed for the improved valve-gear are the small internal forces, and the resulting small consumption of power and back pressure on the governor, in cases where the latter is employed.

In the spring mechanism for the exhaust-valve, the spring is under its greatest compression when the valve is closed, since the force due to gravity acts in the opposite direction to that in which it acts in the admission valve.

### IMPROVEMENTS IN STREET SWEEPING MACHINES.

**Hiram D. Layman and Florence W. P. Layman, of Hartford, Connecticut, U.S.A.**  
March 23rd, 1905.—This invention relates to street sweepers, and among the main objects in view are to produce a comparatively light draft machine of this class



that is adapted to efficiently gather from the street surface, regardless of inequalities and subsequent to a light sprinkling of the same, brush the dirt so gathered upon an elevator, and finally deliver said dirt to a receptacle, where it is evenly distributed preliminary to a discharge into waiting carts; to adapt such machine to carry on the several steps of its entire operation under cover, and therefore avoid escaping dust, germs, and dirt; to provide for ready adjustments of the sweeping and dirt-receiving mechanisms, and finally to have the machine under ready control of driver or operator while mounted on the usual seat at the front of the machine.

Upon a suitable running gear, comprising the usual front and rear wheels, is supported on sills the wagon or body portion. The wagon or body portion may be, and preferably is, subdivided longitudinally, forming an upper and lower compartment. The upper compartment is the dirt receptacle, and in the present instance is provided at one side with a downwardly and outwardly swinging door, hinged at its lower edge, whereby, when lowered, it may serve as a chute. The lower compartment forms the water-compartment or tank, which may be filled in the usual manner from any of the city water plugs. It may be provided at its front with a suitably covered manhole, through which access may be had to its interior. Aside from these features, and the water discharge, a seat is provided for the driver, adjacent to which the various levers, etc., are arranged for controlling the sweeping, dirt receiving, dumping, sprinkling, and clutch-mechanism. In the bottom of the dirt receptacle is a series of parallel rolls having sprocket wheels on their ends, and a discharge apron above them, by which the contents are discharged. At the rear of the wagon body is an elevator frame which receives the material brushed up by the revolving brush, and delivers it to the dirt receptacle beforementioned.



## NEW PUBLICATIONS.

### "INVESTIGATIONS OF MINE AIR."

An account by several authors of the nature, significance and practical methods of measurements of impurities met in the air of collieries. Edited by the late Sir Clement Le Neve Foster, D.Sc., F.R.S., and J. S. Haldane, M.D., F.R.S. Charles Griffin and Company, Ltd. 6s. net.

A melancholy interest attaches to this volume, the greater part of which was almost complete when, by the unexpected death of its talented editor, the mining industry sustained an irreparable loss, and the completion of the work had to be undertaken by Dr. Haldane. Originally the book was intended by Sir Clement for the use of students of the Royal School of Mines, its aim being to give them an account of this important subject with reference to both coal mines and metalliferous mines at home and abroad. The first part is a translation of a paper written by Professor Brunck, of the Freiberg Mining College; here an account is given of the normal and abnormal constituents of mine air, including a description of the analysis of mine air by a number of eminent German chemists; this is followed by M. Léon Poussiguet's treatise on the measurement of air currents and fire-damp at the Ronchamp collieries, which are of a decidedly fiery nature. Dr. Haldane is personally responsible for the third part which deals with the examination of mine air. A description is given of the rapid methods of analysis which were devised by him during recent years in the course of his investigations in mine air.

Sir Clement Le Neve Foster's notes concerning the sensations, symptoms and after-effects of carbon monoxide poisoning are of more than ordinary interest, and it is impossible to read them without the greatest admiration for the cool heroism displayed by the writer under such perilous circumstances. They were written at Snaefell at the time of the calamity. Sir Clement was one of the rescue party and owing to an accident they were in danger of suffocation, yet despite imminent death, the enthusiasm of the scientist asserted itself and during the time they awaited rescue, he made these notes, to use his own words, "because it is possible that they may be of assistance to those who are investigating the subject from a scientific point of view." Apart from the technical value of the book, the work forms a fitting memorial of a distinguished mining engineer, and as such it will no doubt meet with ample appreciation from a wide circle of his admirers.

### "ORDINARY FOUNDATIONS,"

Including the coffer-dam process for piers, with numerous practical examples from actual work. By Charles Evan Fowler. Second edition, revised and enlarged. New York: Wiley and Sons; London: Chapman and Hall. 15s. net.

The second edition of this admirably illustrated volume bears ample evidence of painstaking revision; a considerable amount of fresh data has been added to the text by which the subject of ordinary foundations is more effectively dealt with. Notable among the additional matter is the section devoted to the construction of piers by the use of metal cylinders; with timber caissons by open dredging; and the construction of ordinary-sized foundations by the use of pneumatic caissons. The bearing capacity of soils has received special attention, while a new chapter dealing with cement and concrete has been added which includes valuable tables giving the amount of material required for concrete of different proportions. The volume opens with an interesting review of the historical development of this section of

engineering skill, then follows a discussion on construction and practice, covering crib coffer-dams, cribs and canvas, pile-driving and sheet-piles, and construction with sheet-piles. Metal construction, cylinders and caissons, pumping and dredging, having received attention, the writer deals exhaustively with foundations, citing many notable examples. The succeeding chapters are devoted to location and design of piers, cement and concrete, timber piers and timber preservation.

## NEW CATALOGUES.

**The Lahmeyer Electrical Company, Ltd.,** 109-111, New Oxford Street, W.C. A folding price list issued by this firm deals with their new type small single phase motors—slip ring and squirrel cage; 50 cycles. These machines are all fitted with the firm's improved patent ball bearings which it is claimed greatly reduce the oil consumption and frictional loss. They can be affixed in almost any position, on the floor, the wall or ceiling, and are very suitable for electric driving in all places where space is a consideration.

**Gent and Co., Ltd.,** Faraday Works, Leicester.—A price list reaches us of the firm's "Royal" dry cell. It is claimed that these have an extraordinary capacity in ampere hours, when the discharge rate is low. The cells are contained in papier-mâché cases, sealed with materials which do not "run" in warm situations or tropical climates. A special feature is the improved carbon terminal, which insures secure clamping of the line wire, without the use of screw-driver or pliers. Gent's "Bell Pull" or "Working Arm," is also described in a pamphlet. It is a special contrivance for controlling operations from a distance by means of an ordinary electric bell push. It can be connected up to an ordinary bell or whistle, but it also useful for a number of purposes where a long pull and a strong pull is required, e.g., operating valves, stopping engines, pulling bolts, releasing catches, and lifting penstocks, etc. The large size apparatus gives a pull of 60 lb. through 1 in., that is, it will lift a weight of 60 lb. or pull against a spring of that pressure a distance of 1 in., or 30 lb. through 2 in., 15 lb. through 4 in.; etc, whereas, the smaller gives a pull of 30 lb. through 1 in., or its equivalent.

**The British Thomson-Houston Company, Ltd.,** Rugby.—The voltage regulation of generators, more especially of the alternating-current type has long been recognised as of great importance. The British Thomson-Houston Company, Ltd., realising this fact, have developed and placed upon the market regulators for automatically accomplishing this result independently of speed changes and variations in load. Those interested are recommended to write for pamphlet No. 178, which describes the firm's voltage regulators for both alternating and continuous current generators. Pamphlet 179 describes and illustrates some of the most recent generating and sub-station switch gear installed by the company. Switchboards are used for such a variety of purposes and under such varied conditions, that it is not practicable to absolutely standardise all classes of boards. We are advised, however, that the British Thomson-Houston Company, have a completely standardised line of circuit breakers, switches, instruments, etc., etc., the general disposition of these with regard to the board being, as far as possible, the same in all cases.

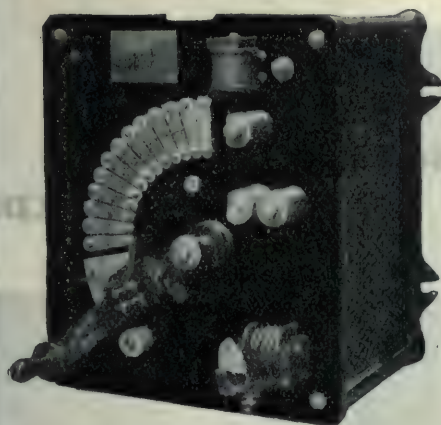


# PAGE'S WEEKLY

## Miscellaneous

# "IGRANIC"

PATENTED



LEAFLET P.M. 10.

MEANS  
A  
BRITISH MADE  
MODERNISED  
RHEOSTAT.

**STURTEVANT ENGINEERING CO.,**  
LTD.,

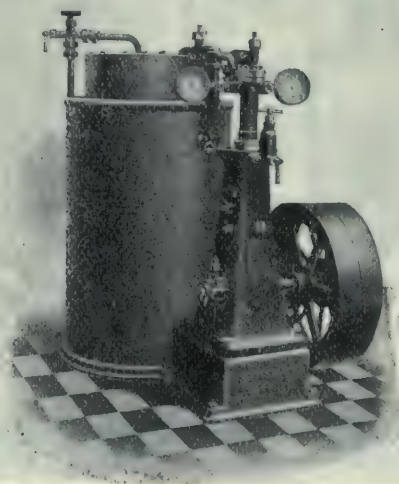
147, Queen Victoria Street, London, E.C.

## Ice Making and Refrigerating Machinery.

CARBONIC  
ANHYDRIDE ( $\text{CO}_2$ ).



AMMONIA  
COMPRESSION  
and  
LOW PRESSURE  
ETHER SYSTEMS.



Over 2,600 Machines  
Built and Sold.



Results Guaranteed.



Prompt Deliveries.



AWARDED SILVER  
MEDAL, R.A. SHOW,  
1904.

## H. J. WEST & CO., Ltd.,

CABLES: "SAXOSUS."  
TELEGRAMS: "COPPERWORM."  
PHONE: 879 HOP.

114-118, SOUTHWARK BRIDGE ROAD,  
LONDON, S.E.

Contractors to H.M. Government, War Department, and India Office.



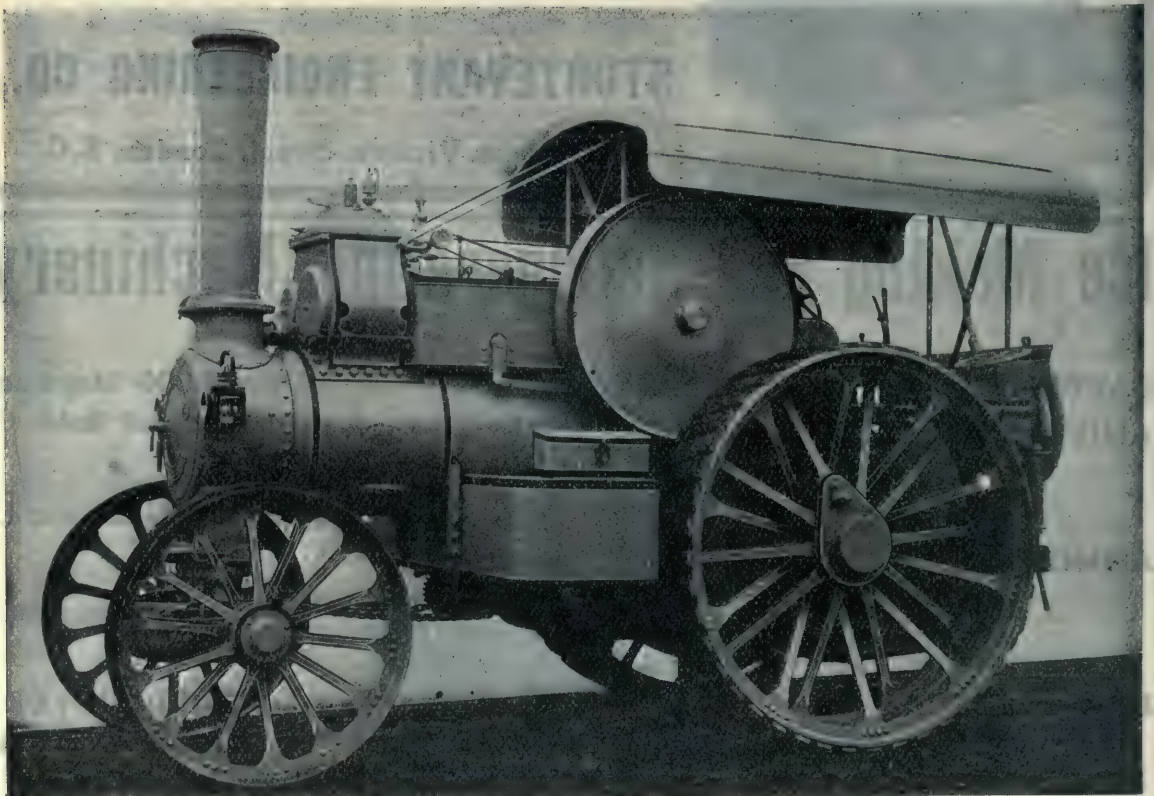


# JOHN FOWLER & Co.

## (LEEDS) LIMITED.

**Electrical and General  
Engineers.**

**Steam Plough Works:  
LEEDS.**



Fowler's Road Locomotive. Designed for all kinds of Steam Haulage, and is also available for temporary belt driving. Three sizes of this Engine are standardized, and employed approximately for 20, 30, and 40 ton loads. A special heavy Engine is also made equal to a load of 50 tons, and called the "Lion" type. The Engine was thus named by the War Office Authorities, who employed a number of them in the South African Campaign.

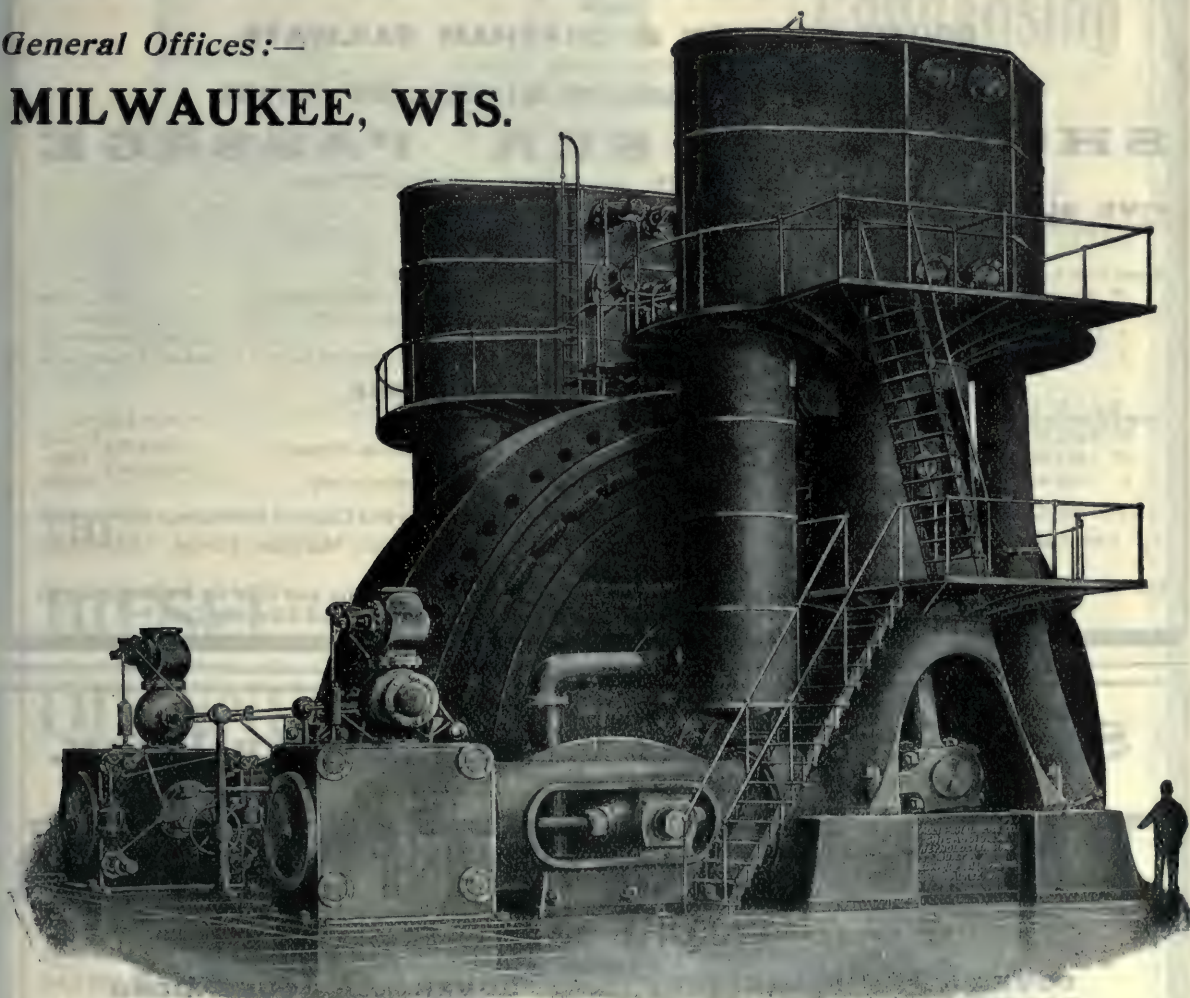




# ALLIS-CHALMERS Co.

General Offices:—

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SOLE BUILDERS OF—

***Reynolds' Engines for Power Plants,  
Rolling Mills, Blowing Engines, etc.***

General European Headquarters:—

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[WRITE FOR CATALOGUES.]





# NORTHERN RAILWAY OF FRANCE

AND  
SOUTH EASTERN & CHATHAM RAILWAYS.

FREQUENT and RAPID COMMUNICATION BETWEEN LONDON and PARIS.

## SHORTEST SEA PASSAGE

(ONLY ABOUT SIXTY MINUTES).

**FIVE QUICK SERVICES DAILY, as under:—**

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Depart. from London.	Arrival in Paris.	Depart. from Paris.	Arrival in London.
† 9.0 a.m. { For PARIS only ...	4.45 p.m.	† 8.30 a.m. For Intermediate Stations	4.55 p.m. { Charing Cross
(Charing Cross Station) { For Intermediate Stations ...	6.5 p.m.	† 9.50 a.m. For CALAIS only ...	Station.
† 11.0 a.m. from Victoria Station ...	6.45 p.m.	† 11.35 a.m. ...	6.45 p.m. Victoria Station
† 9.0 p.m. " Charing Cross Station ...	5.50 a.m.	† 8.40 p.m. ... Intermediate Stations	5.40 a.m. Charing Cross
			Station.

### Via FOLKESTONE AND BOULOGNE.

Depart. from London.	Arrival in Paris.	Depart. from Paris.	Arrival in London.
† 10.0 a.m.	6.5 p.m.	† 8.30 a.m. Intermediate Stations	3.45 p.m. { Charing
† 2.20 p.m. } from Charing Cross Station ...	9.15 p.m.	† 2.40 p.m.	10.45 p.m. { Cross
† 2.20 p.m.	11.25 p.m.	† 4.0 p.m. For Boulogne only ...	Station.

† 1st and 2nd Class only. ‡ 1st, 2nd, and 3rd Class. \* Restaurant Car between Paris and Calais or Boulogne, and *vice versa*.  
\*. \* First-class Hotel and Restaurant at the Gare du Nord, Paris, and at Calais Maritime Station. Luncheon Baskets obtained at fixed prices.

The 2.20 p.m. departure from Charing Cross is the fastest connection between London and Bâle for Switzerland and Italy, *via* the Gothard Route. Through Corridor Trains and Restaurant and Sleeping Cars.

## South Eastern & Chatham Railway.

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## Four Royal Mail Routes

DOVER  
CALAIS.

FOLKESTONE  
BOULOGNE.

VIA

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OSTEND.

QUEENBORO  
FLUSHING.

## LONDON-PARIS IN LESS THAN SEVEN HOURS.

Five Services Daily in Each Direction.

### NEW EXPRESS AFTERNOON DINING CAR SERVICE.

Daily (Sundays included), *via* FOLKESTONE and BOULOGNE.

CHARING CROSS	P.M.	PARIS	P.M.
PARIS	2.20	CHARING CROSS	4.0
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### Mail Route *via* Dover and Ostend.

Three Express Services Daily in Each Direction.

### Flushing Royal Mail Route to Germany, etc.

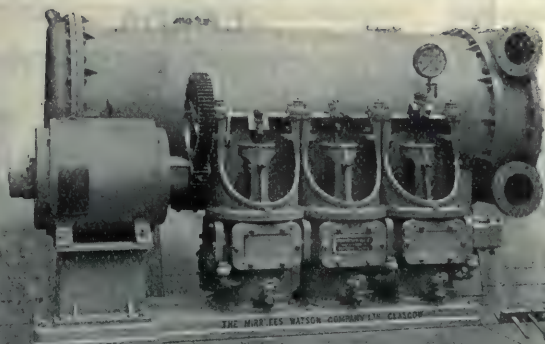
Two Services Daily in Each Direction.

For Full Particulars see S.E. & C.R. Continental Time Tables, price 3d.

VINCENT W. HILL, General Manager.



# PAGE'S WEEKLY Oil Engines, &c.



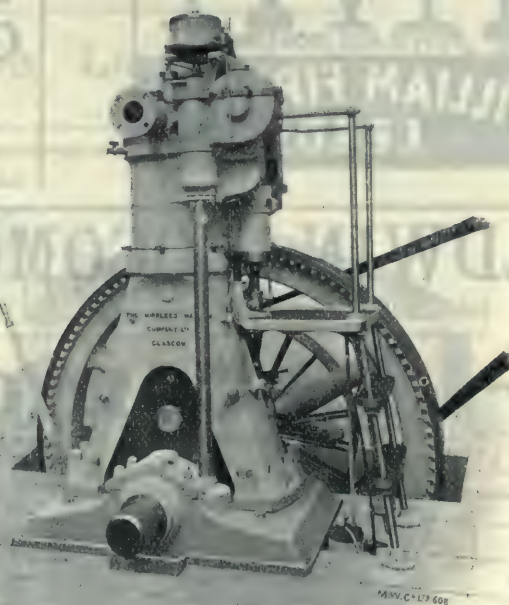
## Condensing Plant . .

OF EVERY DESCRIPTION.

Speciality :—  
HIGH VACUUM.

## THE DIESEL OIL ENGINE

IS THE MOST ECONOMICAL ENGINE MADE, AND IS MORE RELIABLE THAN ANY OTHER OIL ENGINE.



# THE MIRRLEES WATSON Co., Ltd.,

GLASGOW.

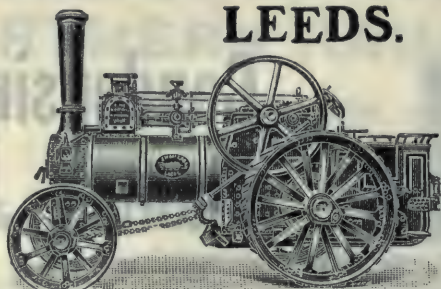


# PAGE'S WEEKLY

## Locomotives, &c.

### McLAREN'S Traction Engines. LEEDS.

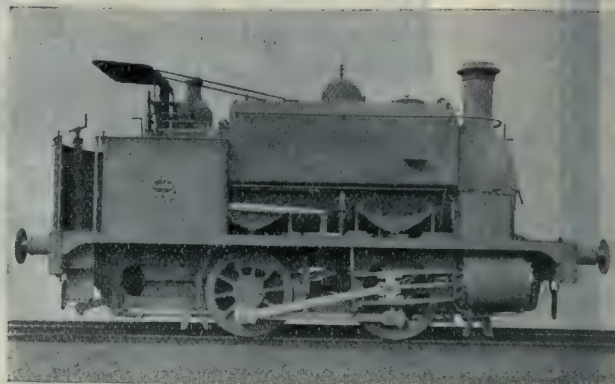
Cable Address: "McLAREN, LEEDS."  
Codes used:  
A B C 4th and 5th Editions.  
LIEBER'S.



Catalogues and Pamphlets mailed free on application to—  
J. & H. McLAREN, Midland Engine Works, LEEDS.

**RAILS**  
FISHPLATES, BOLTS, SPIKES, CHAIRS &c.  
  
POINTS AND CROSSINGS.  
**WILLIAM FIRTH LTD  
LEEDS**

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MANUFACTURERS OF  
**TANK ENGINES**  
Of all Descriptions.

Designs and Specifications Supplied  
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Telephone: 528.

## BALDWIN LOCOMOTIVE WORKS.

Broad  
and Narrow  
Gauge

# Locomotives

Single  
Expansion  
and Compound

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Furnace  
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Industrial  
Locomotives.



Electric  
Locomotives  
with  
Westinghouse  
Motors and  
Electric Trucks.

GRAND PRIZE AND GOLD MEDALS AWARDED BY THE LOUISIANA PURCHASE EXPOSITION.

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General Agents: SANDERS & CO., 110, Cannon Street, London, E.C.

Cable Addresses: "BALDWIN, PHILADELPHIA"; "SANDERS, LONDON."



# PAGE'S WEEKLY

## Destructors, &c.

# "Horsfall" Destructors.

LOW WORKING COSTS.

NO NUISANCE.

CHEAP STEAM.

**Forced Draught.**

For Boilers and Furnaces.



**CLINKER CRUSHING & SCREENING MACHINERY.**  
**MORTAR MILLS. CLINKER BRICK PLANTS.**

**Horsfall Destructor Co., Limited, Armley, LEEDS.**

Telegrams: "Destructor, Leeds."

Codes: Lieber's Standard and A.B.C. (5th Edition).



More durable than iron. Cheapest for all spans up to 100 Feet.

**D. ANDERSON & SON, Ltd.,**

LAGAN FELT WORKS,

**BELFAST.**



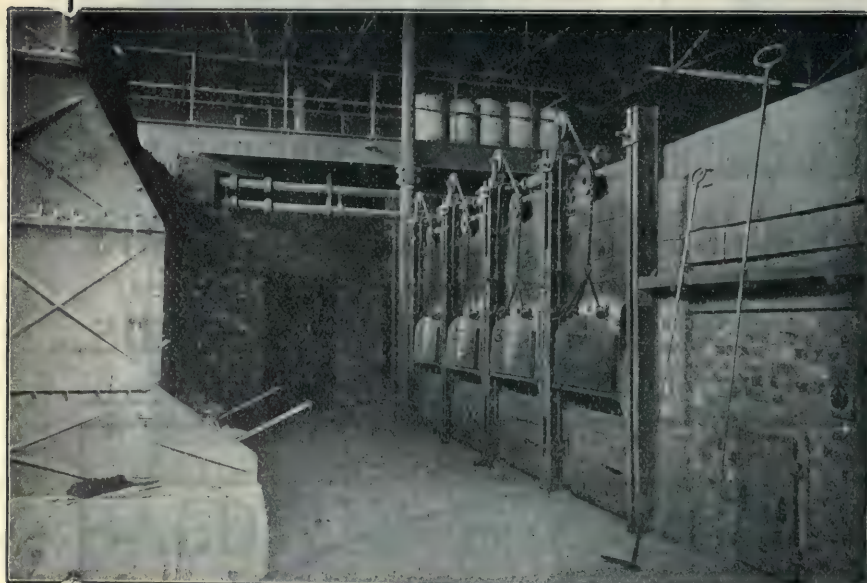
# PAGE'S WEEKLY

## Destructors

# "MELDRUM" DESTRUCTORS

## ARE PRODUCING ELECTRICITY

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Ayr  
Bangor  
Burnley  
Canterbury  
Christchurch, N.Z.  
Cleckheaton  
Colne  
Dartford  
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Over **70** Installations at Home and Abroad.

HIGHEST EFFICIENCY  
AND DURABILITY.

etc., etc.

WRITE FOR FULL PARTICULARS TO

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And 66, Victoria Street, WESTMINSTER.





# RECORD.

At Sheffield Electric Lighting Station, lowest coal cost per unit

• **096**<sup>d.</sup>

with Bennis Stokers, Bennis Compressed Air Furnaces with Patent Hot-Air Feed to Bars and Ellis and Eaves' Induced Draught System.

Mr. S. E. Fedden, Manager to the Sheffield Corporation Electric Supply Department, Commercial Street, Sheffield, says in *Engineering*:—

“Experience with similar machines in the Sheaf Street Station does not lead me to fear any notable increase in the upkeep charges after the period of maintenance has expired.”

**ED. BENNIS & CO., Ltd.,**  
**Little Hulton, Bolton.**



# PAGE'S WEEKLY Electrical Apparatus

## GREENWOOD & BATLEY, Ltd., LEEDS.

MAKERS OF EVERY DESCRIPTION OF

**ENGINEERS' GENERAL TOOLS and of SPECIAL TOOLS**  
for War Material and a Great Variety of Purposes.

Representative in South Africa :—  
W. G. TEBBUTT,  
P.O. Box 1471 Cape Town.

De Laval Patent

Steam Turbine

Dynamos,

Turbine Motors,

Pumps &amp; Fans.

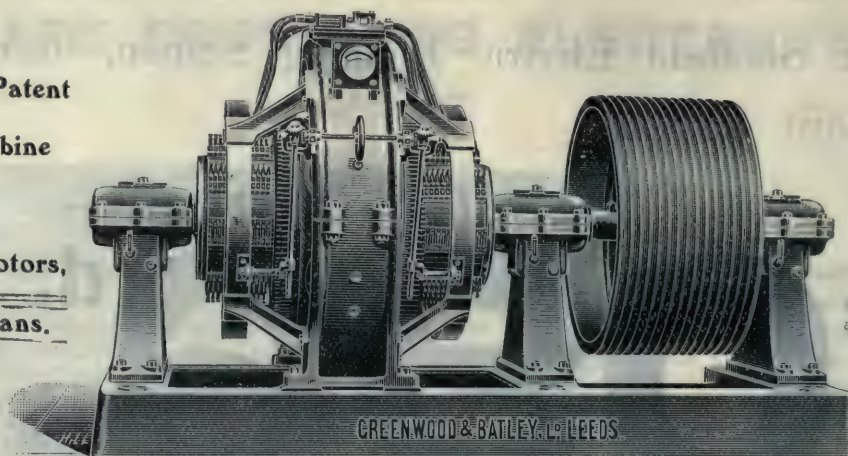
Dynamos &amp;

Motors,

Complete

Electrical

Installations.



Dynamo for Electrolytic Work, 120 volts, 2,500 ampères, 250 revs.

Write for one of our Illustrated Catalogues.

**GUSTAV RICHTER**

Porcelain Manufacturer.

Charlottenburg, near BERLIN.

## "WOODITE" WORKS, MITCHAM COMMON, SURREY.

NOTICE TO ENGINEERS, ELECTRICIANS, STEAM USERS, and OTHERS.—"WOODITE" articles can now be obtained with the utmost despatch. "WOODITE" has stood the severest test for six years. No material in existence can equal it for Steam or Electrical Purposes, and other appliances; has stood every test up to 40,000 volts for 1/8 in. sheet, without breaking down, by the London Electric Light Corporation and others. Ram "U" Hat Joint and Packing Rings, Pump Cups, Gaskets, Manholes, Valves, Sheeting. Patent "WOODITE" G. G. Rings, and all Mechanical and other Goods which have hitherto been manufactured in India Rubber, Leather, etc., can now be made of "WOODITE."

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# PAGE'S WEEKLY Electrical Apparatus

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Capital fully paid up: 60 000 000 Marks

Machine Works • Electrical Apparatus-Works • Cable Works  
Incandescent-Lamp-Works

Three-phase-Generator  
Type NDM.

Up to  
5000 HP



Continuous Current

Threephase Current.

Electric Lighting Plants. • Electric Transmission of Power.  
Electric Railways and Tramways. • Electric Central-Station.  
Electrochemical Plants.

Agencies throughout the World.

Yearly Output 12000 Dynamos and Motors equivalent to 170 000 000 Watt  
10 000 000 Incandescent Lamps.

XI. 6.



# PAGE'S WEEKLY Electrical Apparatus

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LONDON OFFICE:—

17, Victoria Street, Westminster, S.W.

Telegraphic Address: "Phedyna, London."

Telephone: 1061 Victoria.

Telegraphic Address: "Dynamo, Bradford."

Telephone: 952 Bradford.

**DYNAMOS**

UP TO 750 K.W.

**MOTORS**

UP TO 1,000 H.P.

FOR DIRECT AND ALTERNATING CURRENT.

WE HAVE AIMED AT AND HAVE ATTAINED

## PERFECTION IN THE DESIGN OF OUR MACHINES

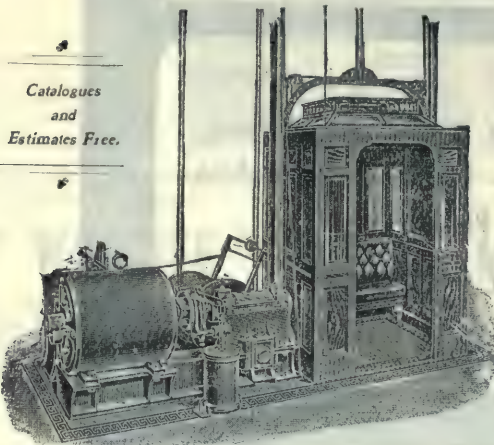
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Write for Particulars.

**WAYGOOD**

Electric  
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Belt Driven  
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**LIFTS.  
CRANES.**



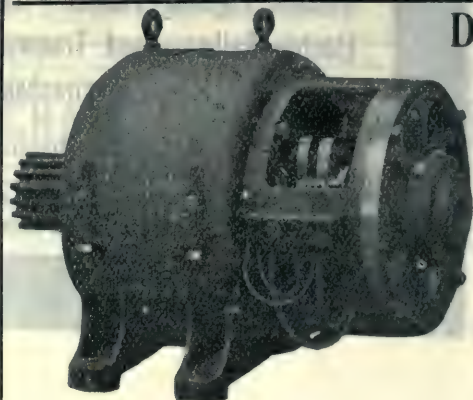
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Telegrams:—"EBONESTOS LONDON"

**B. WEAVER & Co**  
Patentees & Manufacturers of  
**The "EBONESTOS" INSULATOR**  
Reg'd No 23226.  
Suitable for Bushings Nipples, Switch  
Handles & other small Insulating Fittings.

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**Dynamos  
AND  
Motors**  
for all  
purposes.

**NEWTON  
BROS.,  
DERBY.**



# PAGE'S WEEKLY Electrical Apparatus

## ELECTRIC CRANES



UP TO

### 100 TONS

CAPACITY.

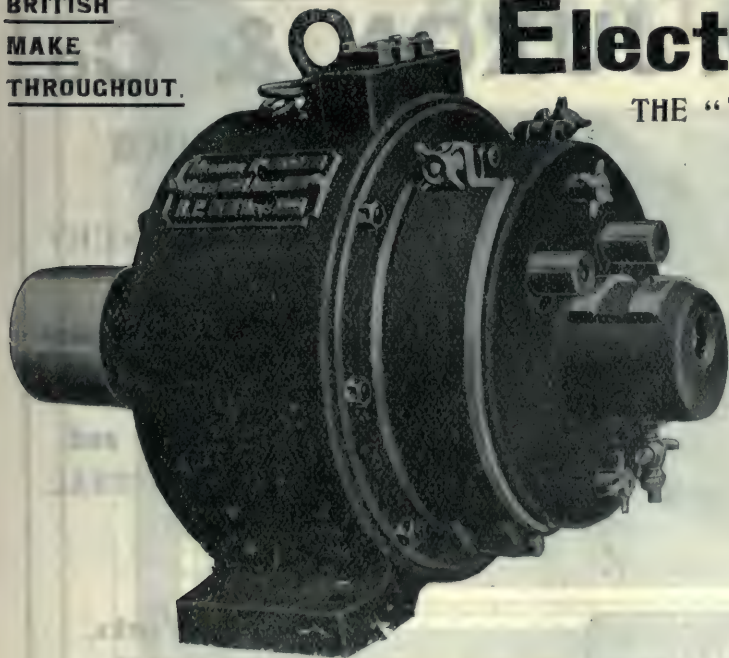
SEND FOR OUR NEW  
CATALOGUE.

**THOMAS BROADBENT & SONS,**  
HUDDERSFIELD. LIMITED.

BRITISH  
MAKE  
THROUGHOUT.

## Electric Motors

THE "TURNER" ENCLOSED TYPE.



Simple Mechanical  
Construction.

Low Temperature Rise.

Sparkless Commutation.

STANDARD SIZES—

$\frac{1}{2}$  h.p. to 40 h.p.

Further particulars on application.

**TURNER, ATHERTON, & CO., Ltd.,** **DENTON,**  
ELECTRICAL ENGINEERS. **MANCHESTER.**



# PAGE'S WEEKLY Transporters, &c.

## Temperley Transporters.

Telegraphic Address:

"TRANSUMO, LONDON."

Telephone No.:

365 LONDON WALL.

**For Rapid and  
Economical  
Handling of  
General  
Cargo,  
Coal, Ore, &c.**

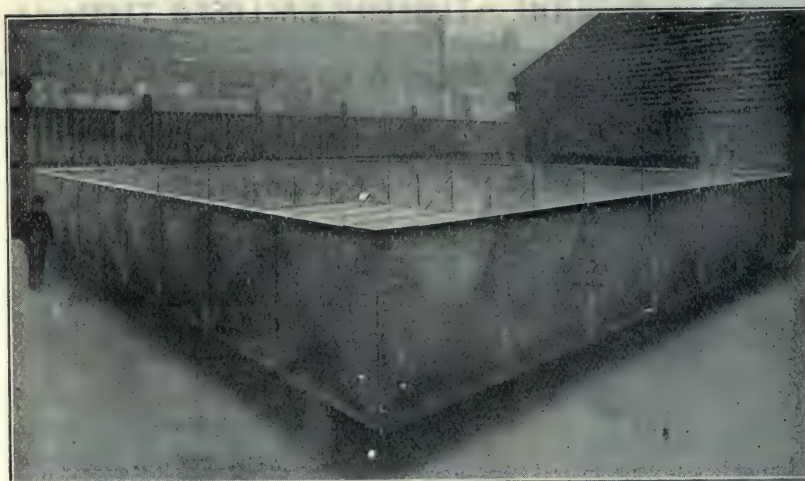


Temperley Patent Fixed Transporter and Travelling Tower Transporter working in conjunction at West Middlesex Water Works, unloading coal and distributing over storage ground. Load, 35 cwt.

**TEMPERLEY  
TRANSPORTER  
COMPANY,**

**72, Bishopsgate Street  
Within, London, E.C.**

## F. A. KEEP, JUXON & Co.



**RIVETTED WORK**

OF EVERY DESCRIPTION.

**TANKS**

FOR

**ALL and EVERY  
PURPOSE.**

**MISCELLANEOUS  
IRON-PLATE and  
CONSTRUCTIONAL  
IRONWORK.**

**Forward Works,  
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National Telephone: 5779.  
Telegrams: "Structures, Birmingham."





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**GAS**  
**PLANTS.**

**FROM 10 HORSE-POWER UPWARDS.**

*Send for Particulars.*

**W. F. MASON, Ltd.,** ALMA WORKS,  
**LEVENSHULME, MANCHESTER.**

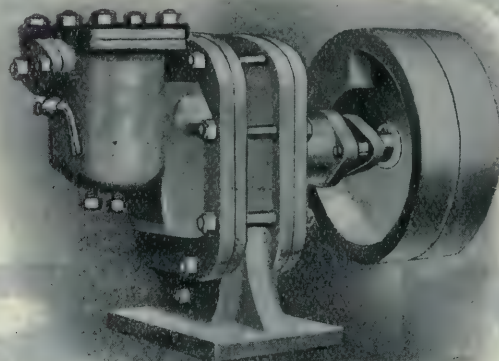


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## The Best Industrial Pump in the World

FOR ANY DRIVE.

FOR  
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LIFT.

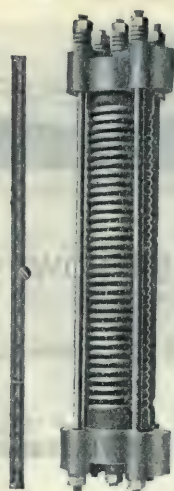


FOR  
ANY  
MATERIAL.

**POSITIVE ROTARY PUMPS, LTD.,**  
23, NORTHUMBERLAND AVENUE, LONDON, W.C.

## A PERFECT INSTRUMENT.

THE  
SIMPLEST  
CONDENSER



IN  
THE  
WORLD.

**CONCENTRIC CONDENSER, LTD.,**

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# TANGYES STEAM PUMPS

FOR ALL DUTIES.

"SPECIAL" DUPLEX  
FLY-WHEEL, &c.,

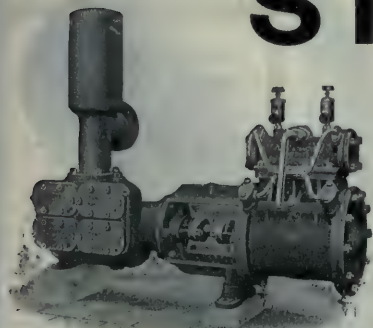
ALSO

*Centrifugal Pumps, Treble-Ram Pumps, etc.*

## Electrically Driven Pumps

A SPECIALTY.

14 x 8 x 12 in. "Special" Pump.



# TANGYES

BRANCHES AT

LIMITED

CORNWALL WORKS,

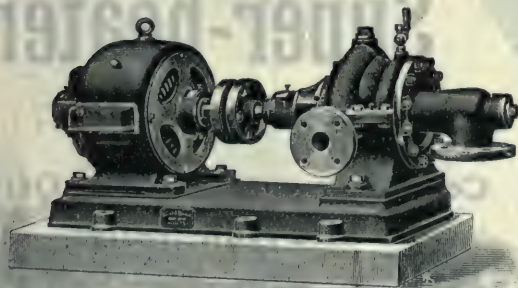
## Birmingham.

London, Newcastle, Manchester, Glasgow, Cardiff, Rotterdam, Bilbao, Johannesburg.

## HIGH LIFT Centrifugal Pumps

MOST SUITABLE AND MOST ECONOMICAL PUMPS  
FOR ALL ELECTRICAL AND INDUSTRIAL SERVICES.

OUR SPECIALITY.



Made for any capacity, for all lifts, with highest efficiency,  
specially for direct coupling with Electromotors, also  
high-speed Electrical Plunger-Pumps for all services.

**WEISE & MONSKI,**  
HALLE, O.S. (Germany).

## J. P. HALL & SONS

Ltd.,

ENGINEERS,

## PETERBOROUGH.

We make a SPECIAL Compound  
Direct Acting Slow Running

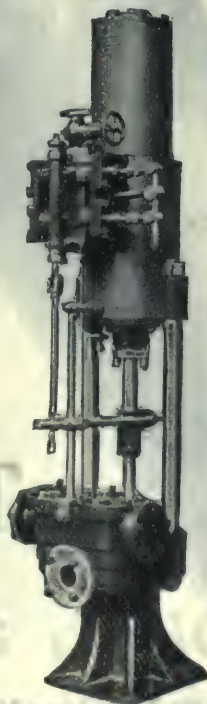
## Boiler Feed Pump

ECONOMICAL AND EFFICIENT.

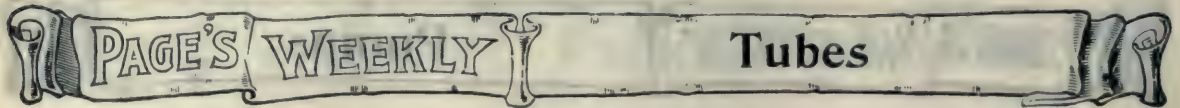
We deliver 100 lbs. of Water for  
the expenditure of 1 lb. of Steam.  
This with our 2,000 gallon Pump,  
and a much higher efficiency as  
the size of the Pump increases.

AN IDEAL PUMP FOR GENERAL  
BOILER FEEDING PURPOSES.

APPLY FOR PARTICULARS.







MANUFACTURERS OF

# Weldless Steel

and . . .

# Iron

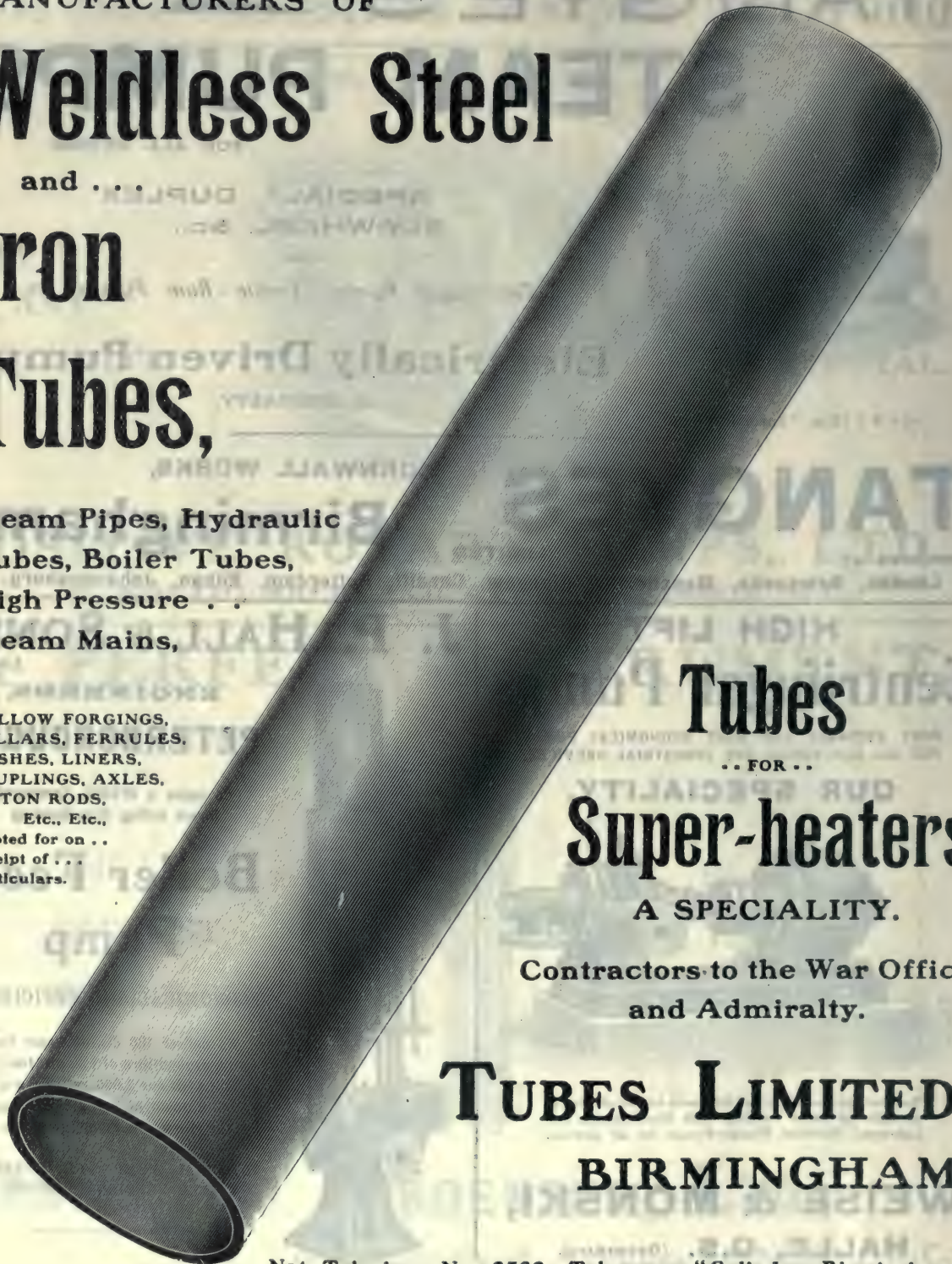
# Tubes,

Steam Pipes, Hydraulic  
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High Pressure . . .  
Steam Mains,

HOLLOW FORGINGS,  
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Quoted for on . . .  
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particulars.



## Tubes

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## Super-heaters

A SPECIALITY.

Contractors to the War Office  
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# TUBES LIMITED

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Nat. Telephone No.: 2582. Telegrams: "Cylinders, Birmingham."



**PAGE'S WEEKLY**

**Tubes, &c.**

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ATLAS WORKS,  
SPRING HILL,  
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## GAS, HYDRAULIC and GENERAL ENGINEERS.

Gas Plants and Constructional Ironwork of all descriptions.

Columns, Girders, Castings, Welded and Rivetted Steel Pipes.

Stamped and Steel Angle Flanges.

Steel Chimneys of all sizes and designs.

Tanks in Steel or Cast Iron for Petroleum & Water.

Pans for Sugar, Cassada, &c., for all Markets.

London Office:

63, Queen Victoria St., E.C.

Telegrams:

"Atlas, Birmingham."

"Intersection, London."

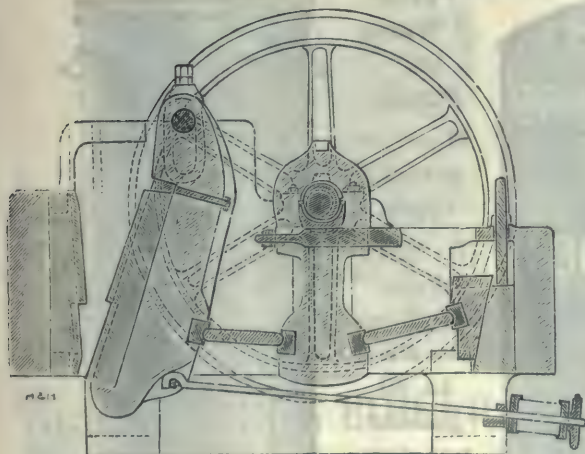
A B C and A1 Codes used.



Steel Lattice Girder Bridge, in one span of 115 feet 10 inches, 12 feet deep, and 13 feet wide, erected over the River Teme at Ludlow, and carrying Welded Steel Main 3 feet 6 inches diameter, for the Birmingham Welsh Water Scheme.

# STONE BREAKERS.

(Improved Blake Type.)



Section of Machine.

**Rollers,  
Screens,  
Gravel Washers,  
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Alexander Street, LEICESTER, ENGLAND.

National Telephone 104



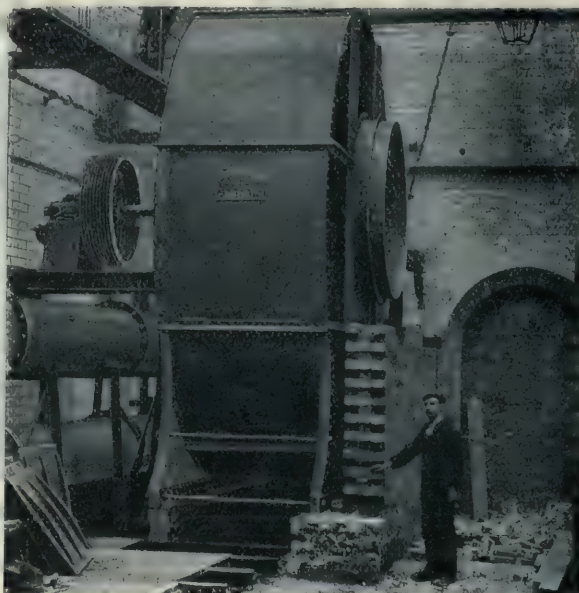
# PAGE'S WEEKLY

## Miscellaneous

### "SIROCCO" FANS

"Sirocco" Induced Draft Fans are now in use at the following Electricity Stations:—

Bedford.  
Brisbane.  
Bury.  
Crewe.  
Glasgow (Port Dundas)  
Greenock.  
Hanley.  
Liverpool (Pumpfield).  
London (Fulham).  
Do. (Westminster).  
Do. (West Ham).  
Do. (Uxbridge).  
Newcastle-on-Tyne  
(Neptune Bank).  
Do. (Carville Station).  
Portsmouth.  
Rotheray.  
South Lancashire  
Tramway.  
Stockport.  
Sunderland.  
Watford.  
York.



7ft. 6in. diameter "Sirocco" Induced Draft Fan, in course of erection at Port Dundas Electric Light Station.

FOR

## INDUCED DRAFT.

"A Fan can be run for about one-tenth of the power represented by the waste heat required to command a good draft in a brick chimney."

Highest Award, Grand Prize,  
St. Louis Exposition, 1904.

## Davidson & Co., LTD.,

"Sirocco" Engineering Works,  
**BELFAST.**

Branches at London, Manchester,  
Glasgow, Calcutta, Colombo,  
&c.

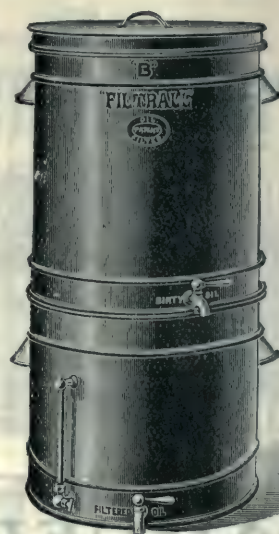
### PATENT OIL CABINETS AND "WASTE OIL" FILTERS



No Engine Room should be without a Cabinet. Stock sizes 6 to 100 gallons capacity.



Patent "Waste Oil" Filters. Made in several types. To filter from 2 gallons per week to 90 gallons per day.



**THE VALOR COMPANY, Ltd.,** ROCKY LANE, ASTON CROSS, **BIRMINGHAM.**



# PAGE'S WEEKLY Boiler Mountings, &c.

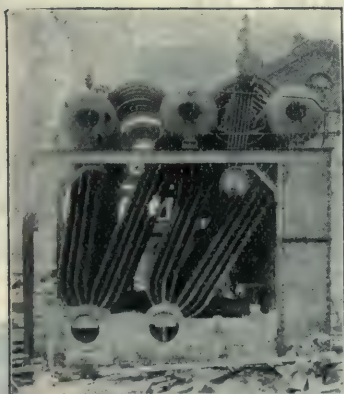
WHEN ORDERING NEW BOILERS OR PIPE LINES

SPECIFY

**WINN'S RELIABLE BOILER MOUNTINGS  
AND VALVES.**

CHARLES WINN & CO., MAKERS, BIRMINGHAM.

## The Stirling Boiler.



**The STIRLING BOILER CO.,**  
Limited,

Head Office and Works:

**MOTHERWELL, N.B.**

London Office: 25, Victoria St., Westminster.



Twist Drills,  
Taps,  
Milling Cutters,  
Reamers.

**H. F. SCHNICKE,**  
CHEMNITZ (Saxony).

**THE PHOTOGRAPHING OF  
MACHINERY, &c.,**

IS EXTENSIVELY UNDERTAKEN BY

**MESSRS. ELLIOTT & FRY**

in any part of the United Kingdom, for which  
work special terms will be sent on application,  
distance being no object.

ONLY ADDRESS:—

**55, Baker Street, LONDON, W.**

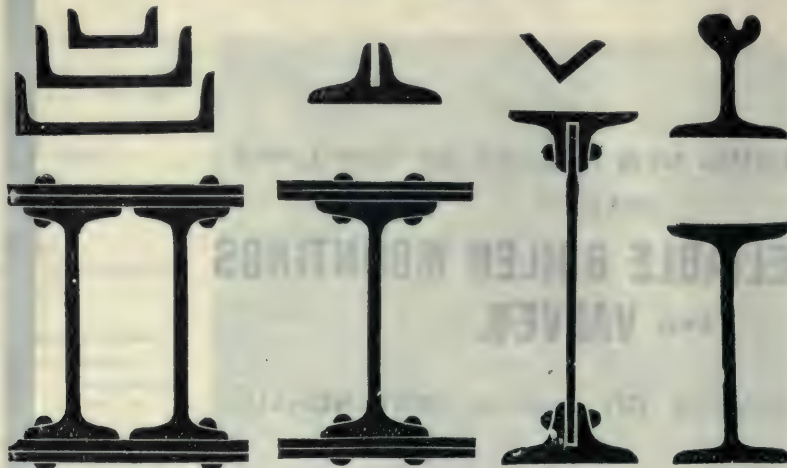
Telegrams:  
PHOTICS, LONDON.

Telephone:  
293 PADDINGTON.



# PAGE'S WEEKLY Iron and Steel

## WALTER SCOTT, Ltd.,



LEEDS STEEL  
WORKS . . .

Telegrams:  
"BESSEMER  
LEEDS."

LEEDS, ENGLAND.

Manufacturers of . . .

**Rolled Steel  
Joists,  
Channels, etc.**

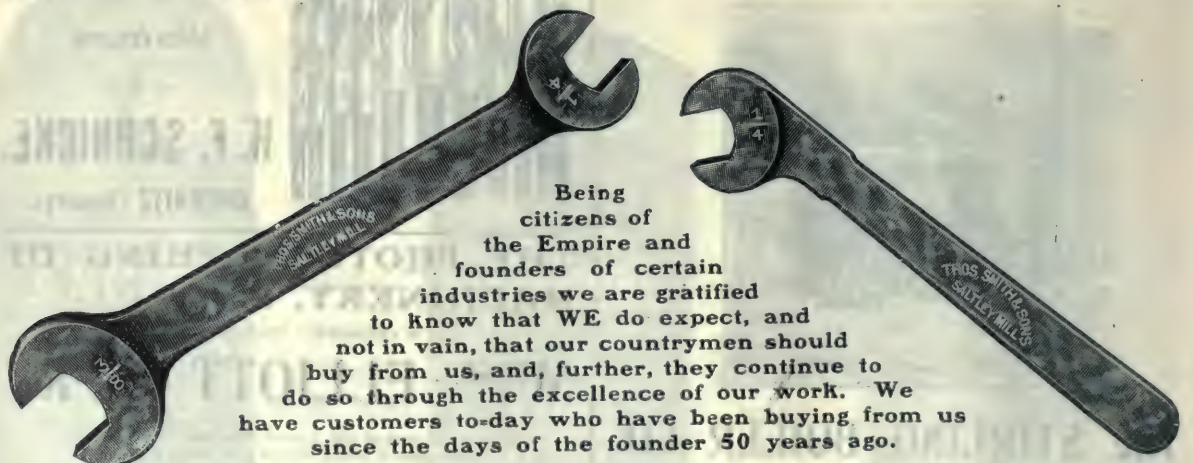
Mild Steel Blooms, Billets,  
Slabs, Tinbars, Rounds,  
and Flats.

Speciality:

**Tramrails.**

*Books of Sections and other information  
on application.*

# Support Home Industries.



Being  
citizens of  
the Empire and  
founders of certain  
industries we are gratified  
to know that WE do expect, and  
not in vain, that our countrymen should  
buy from us, and, further, they continue to  
do so through the excellence of our work. We  
have customers to-day who have been buying from us  
since the days of the founder 50 years ago.

## THOMAS SMITH & SONS, OF SALTLEY, LIMITED, BIRMINGHAM.

ESTABLISHED 1848.



PAGE'S WEEKLY

Iron and Steel

**RIVETS**

ESTABLISHED 1817.

**BOLTS**

CONTRACTORS TO THE

Admiralty,  
War Office,  
India Office,  
Etc.

Manufactured by . .

**T. D. ROBINSON & Co., LTD.,**  
DERBY.

Telegrams :  
"Rivets, Derby."

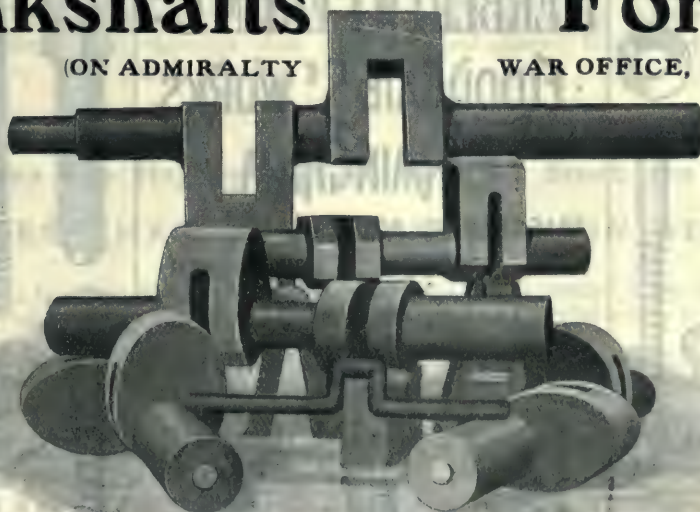
Telephone :  
No. 214.

**SCREWS****Crankshafts AND Forgings**

(ON ADMIRALTY

WAR OFFICE, &amp;c., LISTS.)

BENT  
CRANKS  
(Square  
or  
Round)



FOR  
MARINE  
AND  
OTHER  
PURPOSES.

The above represents a Group of Crank Axes bent by hydraulic pressure,  
all throws bent in position, twisting being dispensed with.

**WOODHOUSE & RIXSON, Sheffield.**





# W. R. Renshaw & Co., Limited,

Manufacturers of . .

RAILWAY WAGONS,  
WHEELS & AXLES,  
AND IRONWORK,  
ALL STEEL HIGH-  
CAPACITY WAGONS,

IRON & STEEL  
STRUCTURAL WORK,  
TANKS, ROOFS,  
RIVETED GIRDERS AND  
PIPES.

London Office:

46, KING WILLIAM  
STREET, E.C.

Phoenix Works.

**STOKE-ON-TRENT.**

**HERBERT W PERIAM LTD**  
**FLOODGATE ST WORKS**  
**BIRMINGHAM.**

TELEGRAPHIC ADDRESS  
 "FLOODGATE" BIRMINGHAM.

TELEPHONE N° 373.

STOCK 250,000. GROSS

 The advertisement features a central text box surrounded by detailed illustrations of various industrial fasteners, including bolts, nuts, washers, and eye-bolts, arranged in a grid-like fashion.





Head Office:  
ST. PAUL'S SQUARE,  
BIRMINGHAM.

WATERLOO CHAMBERS,  
19, WATERLOO STREET,  
GLASGOW.

**SAM<sup>L</sup>. BUCKLEY**

(Successors to BOHLER BROS. & CO.),

**Styrian Steel Works,  
SHEFFIELD.**



OUR HIGH-CLASS CRUCIBLE CAST

## Tool Steel,

melted from the purest **CHARCOAL REFINED STYRIAN** Raw Material, is supplied in various degrees of hardness, especially adapted for the different classes of Tools used by Engineers.

Every Bar is stamped with the Brand denoting the quality and the hardness, and is labelled with a coloured label, which not only shows the purposes for which the

Steel is intended, but also gives the necessary directions for the treatment. The Forging, Hardening, and Welding of our Steel, however, is by no means different from that of other high class Tool Steels, and requires only that skill and careful treatment which forms the basis of success with any Tool Steel of great purity.

**Besides our Higher Grades of Tool Steel, we supply—**

**STYRIAN BESSEMER** and **SIEMENS-MARTIN STEEL** in forged Bars and Shafts.

**STUD STEEL** for Pins, Studs and Bolts, in Black, Chilled Rolled, Blue Reeled or Bright Drawn, guaranteed to bend on its own diameter after being screwed, Whitworth V. thread without distress.

**SILVER STEEL** of the very finest quality, in straight lengths drawn with a high polish.

**MILLING CUTTER BLANKS** forged and swaged by a special process which ensures perfect uniformity and density of material.

**TWIST DRILLS** in our High Speed Blast Hardening "**THREE STAR**" Brand, or in our Extra Quality Middling Hard.

**STEEL** for **MAGNETS** of the greatest permeability and coercive force.

**MINING STEEL** for Granite and Stone Quarries, Coal Boring and General Mining.

**FILES**, both hand and machine cut, of the highest qualities.

**HAMMERS** of every pattern and quality.

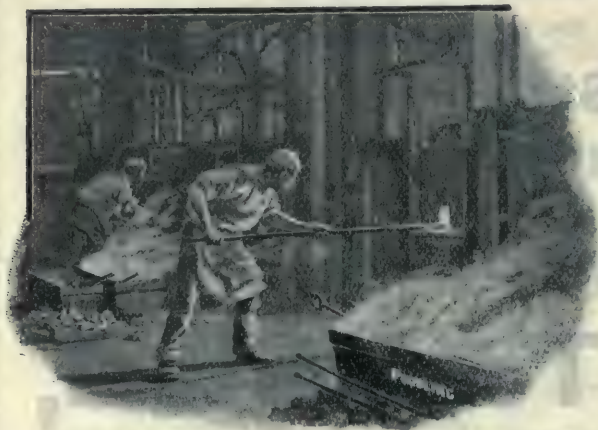
**Contractors to H.M. Government, War Office, Admiralty,  
India Office, and Foreign Governments.**



# PAGE'S WEEKLY

## Iron and Steel

# Farnley Iron



PUDDLING.

Farnley **Bar Iron** is used in **Mining** for pit cages, suspending gear, and other important parts, and on all the leading **Railways** in Great Britain, India, and the Colonies, for shackles and other vital parts subjected to repeated shocks.

Farnley Iron will stretch cold from  $1\frac{1}{8}$  in. to  $2\frac{1}{8}$  in. in a length of 6 in. before fracture, and is safest for **welding**.

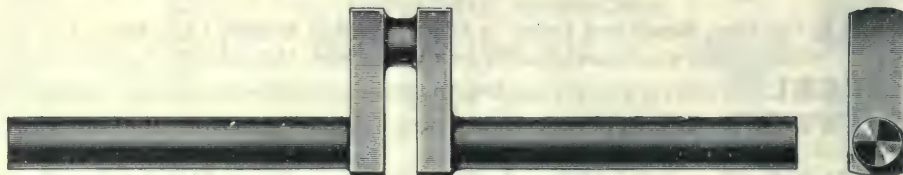


*Address:* The Farnley Iron Co., Ltd., Leeds, England.

ON ADMIRALTY LIST.

Telegrams: "CRANKS, LINCOLN."

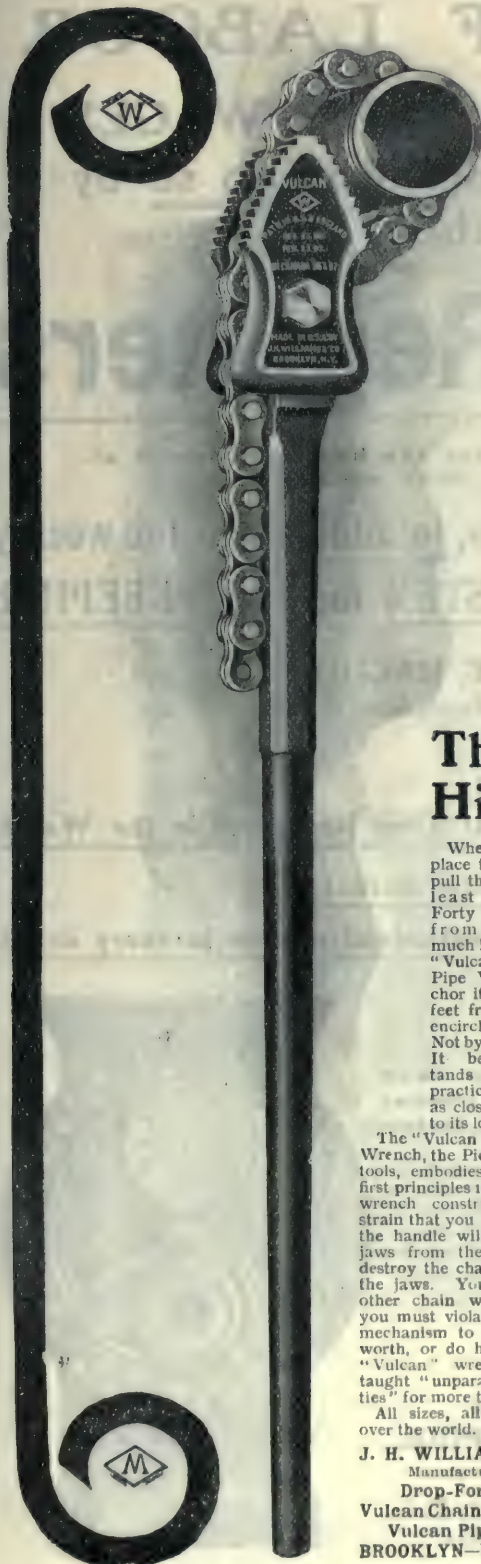
**FOR CRANKS  
& FORGINGS  
OF EVERY  
DESCRIPTION  
WRITE TO**



**CLARKE'S  
CRANK &  
FORGE CO.,  
LTD., LINCOLN,  
ENGLAND.**



# PAGE'S WEEKLY Iron and Steel, &c.



## The Hitch!

Where do you place the horse to pull the load with least exertion? Forty yards away from it? Not much! Does the "Vulcan" Chain Pipe Wrench anchor its chain two feet from its pipe-encircling grip? Not by any means! It better understands mechanical practices and gets as close as possible to its load.

The "Vulcan" Chain Pipe Wrench, the Pioneer of pipe tools, embodies all of the first principles in chain pipe wrench construction. No strain that you can place on the handle will wrench the jaws from the handle, or destroy the chain pockets in the jaws. You may make other chain wrenches, but you must violate "Vulcan" mechanism to approach its worth, or do half its work. "Vulcan" wrenches have taught "unparalleled qualities" for more than 20 years.

All sizes, all dealers, all over the world.

**J. H. WILLIAMS & CO.,**  
Manufacturers of  
Drop-Forgings,  
Vulcan Chain Wrenches,  
Vulcan Pipe Vises,  
BROOKLYN-NEW YORK

INQUIRE  
FOR  
**CAST-IRON  
COLUMNS**  
AND  
**RIVETTED  
STEEL  
STANCHEONS.**

**STEEL  
PIT HEAD  
GEARS**

AND  
**HEAPSTEADS**

FROM  
**HEAD,  
WRIGHTSON,  
& Co., Ltd.,**

TEESDALE IRON WORKS, THORNABY-ON-TEES;  
STOCKTON FORGE WORKS, STOCKTON-ON-TEES;  
EGGLESCLIFFE FOUNDRY, STOCKTON-ON-TEES.





## EMPLOYERS OF LABOUR

Can save at least **5%** ON THEIR WAGES BILL, and thousands of employers do so by the use of the

# "Dey" Time Registers

which are automatic machines for registering the hour and minute at which Employees start and finish work,

and, with the New Attachment provides, in addition to the weekly time and wages sheets, the CARD SYSTEM for COST KEEPING.

The "DEY" combines on **THE ONE MACHINE** the good points of all other Automatic Time Recorders on the market.

They are of British Manufacture Throughout.

They are absolutely the best Time Recorders in the World.

They are the cheapest up-to-date machine on the market.

They are guaranteed perfect in every detail.

### THEY COMPEL PUNCTUALITY.

The "Dey" time and wages sheets combined do away with time books, wages books, and save 90% of clerical work. They are adaptable to every requirement, no matter how complicated.

A firm using 15 machines writes: "We shall be sorry when we change the boiler-shop machine, as it was one of the earliest, and has had the roughest of usage together with the maximum of vibration, and rudest of shocks; but it has gone on working the whole time (nearly six years) night and day, and when it goes to you for repairs, it will be the first time it has been in the infirmary."

Full particulars from the Patentees and Manufacturers:—

## HOWARD BROS.,

10, St. George's Crescent, LIVERPOOL.

TELEGRAPHIC ADDRESS: "SONNEZ, LIVERPOOL."

TELEPHONE: 7150 LIVERPOOL.

London Offices: 100c, Queen Victoria Street, E.C.

TELEGRAPHIC ADDRESS: "COUNTABLE, LONDON."

TELEPHONE: 5690 BANK.





# PAGE'S WEEKLY Time Recorders

## TIME RECORDERS

*of all kinds*  
**FOR ALL TRADES**



THE "BUNNY" KEY RECORDER

**RECORDERS LIMITED**

171 QUEEN VICTORIA ST

LONDON E.C.



# PAGE'S WEEKLY

## Printing

### ARE YOU ON THE LOOK OUT FOR BUSINESS?



If so, you will find  
it a great assistance  
to have a high-class  
and unique Cata-  
logue. We make a  
speciality of striking  
Catalogues which  
are sure to bring  
you business.

**SOUTHWOOD, SMITH & CO., Ltd.,**  
ARTISTIC PRINTERS,  
PLOUGH COURT, FETTER LANE,  
LONDON, E.C.



# PAGE'S WEEKLY Systems for Engineers

## IT WILL WAKE UP THE ENTIRE OFFICE.

### HERE'S THE KEY TO OUR INFORMATION DOOR.

Are you making bills with  
pen ? .....pencil ? .. .....  
or typewriter ? .....

Do you take letter-press  
copy of bills ? .....or loose  
carbon copy ? .....or use  
manifold bill-book ? .....  
or make separate entry in sales  
book or journal ? .....

Do you manufacture and  
ship from the original order as  
received ? .....  
or do you copy the orders for  
your shipping and other de-  
partments ? .....

Is it desirable or necessary  
for you to make more than one  
copy of your orders ? .....

Remarks .....

It is distinctly agreed that  
any plan or suggestions submit-  
ted are to be without expense or  
charge to us, and obligate us to  
no liability direct or indirect.

(Sign) .....

Per .....

Address .....

Date .....

SOMETIMES an office force needs an  
innovation to prove that there are other  
ways than those it has long been using.  
Better ways, simpler ways, cheaper ways,

ELLIOTT-FISHER

BILLING MACHINE

ways.

Would you like to have us tell you how  
you can reduce the cost of your billing and  
book-keeping from one-third to half.

Just inquire.

Address:—

Office System Department:—

## ELLIOTT-FISHER CO.

(Contractors to H.M. Government),

87, Gracechurch Street,  
LONDON, E.C.;

and at

151, Hope Street, GLASGOW;

94, Market Street, MANCHESTER.



# PAGE'S WEEKLY Engineers' Appliances.

## Some "Swan" Points.

WHICH WOULD  
SUIT YOU?

For a Bold Hand - - - use a Broad Point, say a "J" Swan.  
For an Easy Running Hand - - - " Turned-up "Swan."  
For Book-keeping - - - " Short Medium Point "Swan."  
For Shorthand - - - " Long Fine Point "Swan."



Broad.



Med. Brd.



Medium.



Fine.



Broad.



Med. Brd.



Medium.



Fine.

EVERY STEEL NIB CAN BE  
SUCCESSFULLY MATCHED IN

**A "SWAN"**

FOR EVERY HAND AND EVERY  
WORK.

Prices from 10s. 6d., 16s. 6d., 25s., up to £20, post free.

Of all Stationers and Jewellers.

Write for New Catalogue, post free.

**MABIE, TODD, & BARD,**

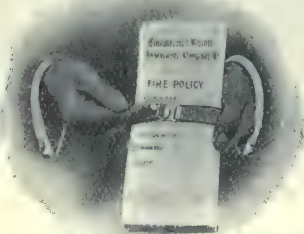
79 & 80, High Holborn, W.C., 93, Cheap-  
side, E.C., 95a, Regent St., W., London;

3, Exchange Street, Manchester; and Brentano's, 37, Ave. de l'Opera, Paris.

## TITAN DOCUMENT BINDER.

Indispensable to

Engineers, Shipbuilders, Electric Lighting  
Stations, Collieries, Iron and Steel Works, &c.



Thousands of firms supplied, some of whom are Sir W. G. Armstrong,  
Whitworth & Co., Ltd., Babcock & Wilcox Co., Ltd., Leeds Forge  
Company, Ltd., Manchester Ship Canal, John I. Thornycroft & Co., Ltd.,  
Denney & Co., Dumbarton, etc., etc.

A SAMPLE SENT FREE ON REQUEST.

**THE TITAN BINDER COMPANY,**

31, Queen Victoria Street, LONDON, E.C.

IMPROVED

Automatic

Numbering

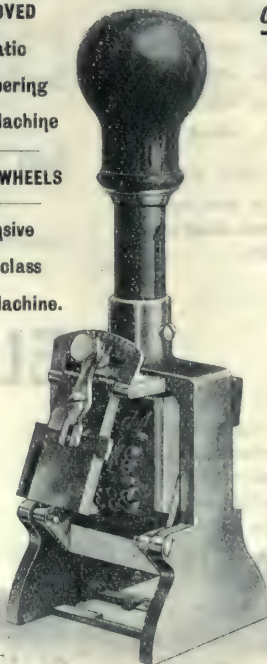
Machine

STEEL WHEELS

Inexpensive

First-class

Machine.



OUR SPECIALITIES:—

Perforating Presses

Embossing „

Company Seals

Steel Dies & Punches

Wrot-iron Brands

Patent Stencil Drums

& Stencil Plates

ENGINEERS'

INSTRUCTION

and NAME PLATES.

RUBBER STAMPS  
SPECIALLY MOUNTED  
With Sponge Rubber Sealing

**THE RUBBER STAMP COMPANY,**

4, Broad St. Corner, BIRMINGHAM.



# PAGE'S WEEKLY Engineers' Appliances

## J. HALDEN & CO.,

8, Albert Square, MANCHESTER.

### Arc Lamp Duplex Radial Photo-Copying Frame . .

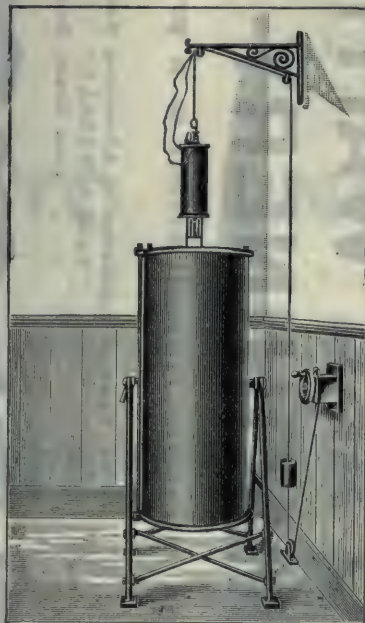
(HALDEN'S PATENT).

Engineer's Electric Frame, very superior, Arc  
Lamp and Lowering Gear, Printing from Two  
Tracings 53" x 31", at one operation ... .. **£42 10 0**

*Other Sizes as per List post free on request.*

#### Advantages of Duplex Radial Photo-Copying Frame.

- A.—Copying indoors at any time where Electric Current is available.
- B.—The Frame when once mounted on the Pedestal remains there.
- C.—Immunity from accident ensured by the Frame remaining on the Pedestal.
- D.—The horizontal position (when placing in or taking out Tracings and Copies) is the most convenient for Operators.
- E.—Two full-size Tracings can be copied at one operation.
- F.—The glass plates can be very easily cleaned when Frame is horizontal.



Copies Two Tracings at One Operation.

### The Reliance Level No. 927a.

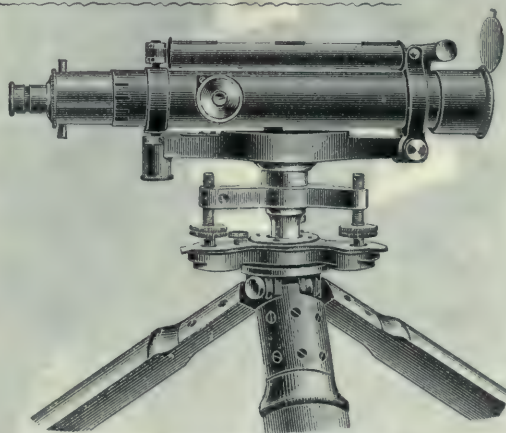
This Instrument is the Acme of Reliability  
and Accuracy, and is manufactured in our own  
Workshops in Manchester.

*Illustrated List post free on request.*

No. 927a. 14 in. Reliance Level, without compass **£13 0 0**  
" " 14 in. Reliance Level in Aluminium **14 10 0**

*Sample Sheet, 22 by 15,  
post free on request.*

SEND FOR DRAWING OFFICE  
MATERIAL CATALOGUE.



No. 927a Reliance Level.

### The "ARC" Tracing Cloth,

Super, Super Quality, guaranteed)  
30 inches wide by 24 yards roll) **16s. 6d.**

London, Manchester, Newcastle-on-Tyne, Birmingham, and Glasgow.



# A NEARER VIEW



Moon's Age, 10 days 12 hours. Lick Observatory, 1890.

Photographed by Ritchie with 40-inch Telescope.

OF MOON OR PLANET

NEEDS A MORE POWERFUL TELESCOPE,

*But if you want to discover the*

## PEOPLE WHO ARE WAITING FOR YOUR MACHINERY

There is nothing like an attractive Advertisement in a progressive paper.

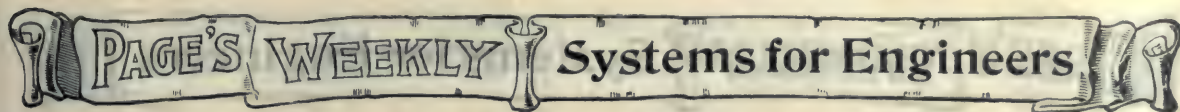
We have made "Page's Weekly" a Success.

We can make a Success of your Advertisement.

Rates on application to Advertising Manager,  
"PAGE'S WEEKLY."

Clun House, Surrey Street, Strand, W.C.





# NO ONE CAN AFFORD

in these days of severe competition when "office expense" as well as factory cost needs careful watching,

# TO IGNORE

the present-day methods used by the most progressive and successful concerns.

# THE TIME & MONEY

saved in one year amply repays the first "investment," which can never be reckoned an "expense," for

# PERPETUAL SYSTEMS

are practically "gilt-edged securities," and, their use has always been extended after a fair practical trial.

---

FOR FULL PARTICULARS WRITE ON YOUR BUSINESS HEADING TO P.D.L. DEPT.

## THE TRADING & MANUFACTURING CO., Limited,

TEMPLE BAR HOUSE,

FLEET STREET,

Telegrams : "DEVIBERS, LONDON."

LONDON, E.C.



# PAGE'S WEEKLY Systems for Engineers

## SHANNON SYSTEMS

### Dealing with Correspondence.

**FIRST:** Copy your letters, agreements, and other outgoing correspondence on the **Shannon Letter Copier**, which copies ten times as quickly as an ordinary screw press.

**SECOND:** File the copies of answers with the original letters received in a **Shannon Letter Filing Cabinet**, in alphabetical and chronological order.

### THE RESULT:

Perfect Copies. Instant reference to outgoing and incoming correspondence. Great saving of time, worry, and hard cash.



The Shannon Letter Copier.



Shannon Letter Filing Cabinet.

Write for our Booklet No. 20, which deals exhaustively with this modern system.

## The Shannon Ltd.,

Head Offices and Showrooms: **Ropemaker St., LONDON, E.C.**

West End Branch: **Denman House, 20, Piccadilly, W.**  
**F. W. SCHAFER, Managing Director.**

# JOHN SWAIN & SON LTD

*Specialists in the production of*  
**HIGH CLASS ILLUSTRATED CATALOGUES**  
**· ADVERTISEMENTS · SHOW CARDS · etc**

SEE OUR SPECIMENS IN  
 "HALF TONE"  
 "THREE COLOUR"  
 "WOOD ENGRAVING"  
 "LINE" &c.

**58 Farringdon St.**  
**LONDON E.C.**



Telegrams: "ISOCROMATIC LONDON." Telephones: NATIONAL 796 HOLBORN. POST OFFICE, 1905 CENTRAL.



# PAGE'S WEEKLY

## Miscellaneous

# DON'T HESITATE,

BUT INSTRUCT YOUR STATIONER TO SUPPLY

Every Sheet

bears this

Watermark, 

# BEDFORD

# BOND

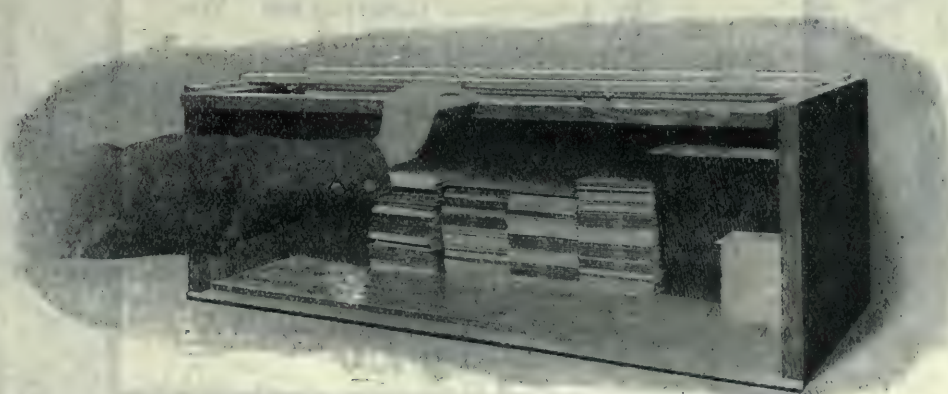
*Manufactured in  
White and Five  
Tints.*

*Specially adapted  
for Departmental  
Stationery.*

## SUPERFINE TYPEWRITING PAPER.

## A Section of Our New Expansion Cabinets.

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WE CAN HELP YOU TO SAVE EXPENSES,  
THAT'S ALL—BUT IT'S ENOUGH.

THE LYLE COMPANY, LIMITED,

HARRISON STREET, GRAY'S INN ROAD,

LONDON, W.C.



# PAGE'S WEEKLY

## Miscellaneous

### Type Talks.

Your advertisements and catalogues ought to tell your story as convincingly as you tell it to the caller who wants to do business.

But do they? If you are not satisfied with the results of your advertising, may we offer you our assistance? We can make type talk for you; and it will not be a one-sided conversation. We will make the other people reply.

Write us—

**THE SPOTTISWOODE  
ADVERTISING  
AGENCY, Ltd.,**

**Clun House,  
Surrey Street, Strand, W.C.**



# PAGE'S WEEKLY

## Printing



**WE INTENDED TO PUT  
YOU TO A LITTLE  
TROUBLE**

TELEPHONE No 4774.

In order to read this advertisement, because what we have worth remembering to you and you would wish it we can turn it the right way as easily as we are benefactors to the Engineering business because we specialise EXCLUSIVELY for Engineers. Catalogues, Pamphlets, and High-class Circulars, as well as the Finest Illustrated Half-tone Blocks.

**THE ATLANTIC PRESS  
ENGINEERS' PRINTERS,  
LIMITED,  
MANCHESTER, S.E.**

Weymouth Street,  
TRADE MARK.



PAGE'S WEEKLY

Miscellaneous

TEON

THE BEST BELT FOR EXPOSED SITUATIONS.

CONTRACTORS TO H.M. GOVERNMENT, FOREIGN GOVERNMENTS HOME & FOREIGN RAILWAYS.  
INCORPORATING FIRMS ESTABLISHED OVER 100 YEARS.

**FLEMING, BIRKBY & GOODALL, LTD.**  
HEAD WORKS & REGISTERED OFFICES,  
**West Grove Mill, HALIFAX.**

13 INTERNATIONAL EXHIBITION AWARDS.

STANDARD OAK-TANNED LEATHER BELTING.

GILBERT WOOD SPLIT PULLEYS, PRINCIPAL AGENTS LARGE STOCK HELD.

SOLE MAKERS OF TEON BELTING the Premier Heat, Steam, Water & Acid Proof Belt.

HYDRAULIC LEATHERS and all kinds of MILL & MECHANICAL LEATHERS.

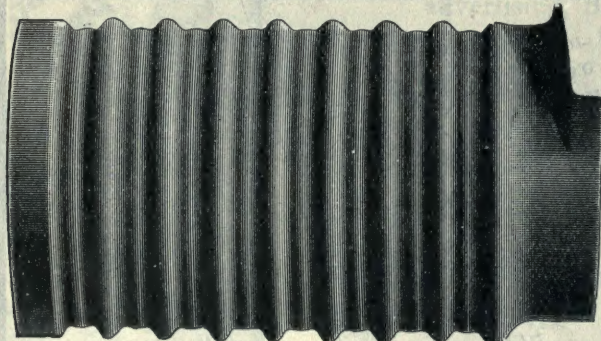
SEWN AND SOLID WOVEN COTTON BELTING.

"SUPERIOR" HAIR BELTING.

TELEGRAPHIC ADDRESS: "FLEMING, HALIFAX."  
TELEPHONE No. 48 HALIFAX.

BELTING  
NOT AFFECTED BY STEAM, HEAT, OR COLD.

Telegrams: "FLUES, LEEDS." Telephone (National) 1674. A 1 &amp; A B C Codes used.



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## Deighton's Patent Flue & Tube Company, Ltd.

### DEIGHTON'S FURNACE.

The Destructive Tests have proved the DEIGHTON FURNACE to be the strongest to resist collapse ever made.

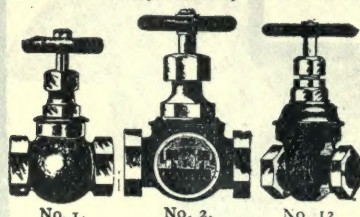
It is also unequalled for Uniformity of Thickness and Easy Scaling.

**MAKERS OF MARINE and LAND BOILER FURNACES.**

Awarded 2 Bronze Medals,  
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**Vulcan Works,  
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### No. 1. Standard Globe Valve.

$\frac{3}{4}$ in. 1in.  $1\frac{1}{2}$ in. 2in.  
4/- 5/6 9/- 11/6 16/-

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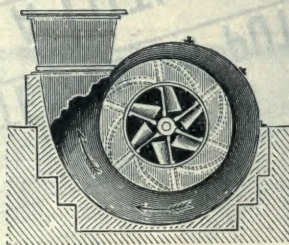
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**VALVES ALL TYPES. LIBERAL DISCOUNT.**

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IN USE ON MINES ALL OVER THE WORLD.



Furnace Gas Cleaning Fans  
(In large use).

Induced & Forced Draught Fans.

Fans for Ventilation of Buildings.

**ADVANTAGES:-**  
Highest Economy in Power.  
Small Size of Fans.

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# GREEN'S ECONOMISER

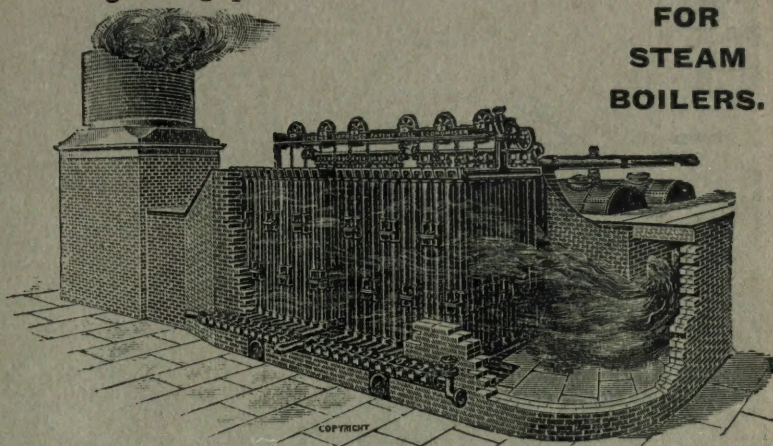
Saves 15 to 25 per cent. in Coal.

**MAKES  
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**IN THE BOILER HOUSE.**

More Steam and higher efficiency at less cost. Large reserve of feed water at evaporative point always ready on sudden demand for extra power.

*Catalogue gives details.*



**FOR  
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BOILERS.**

**E. GREEN & SON, Ltd.,** WAKEFIELD, MANCHESTER, LONDON, AND GLASGOW.

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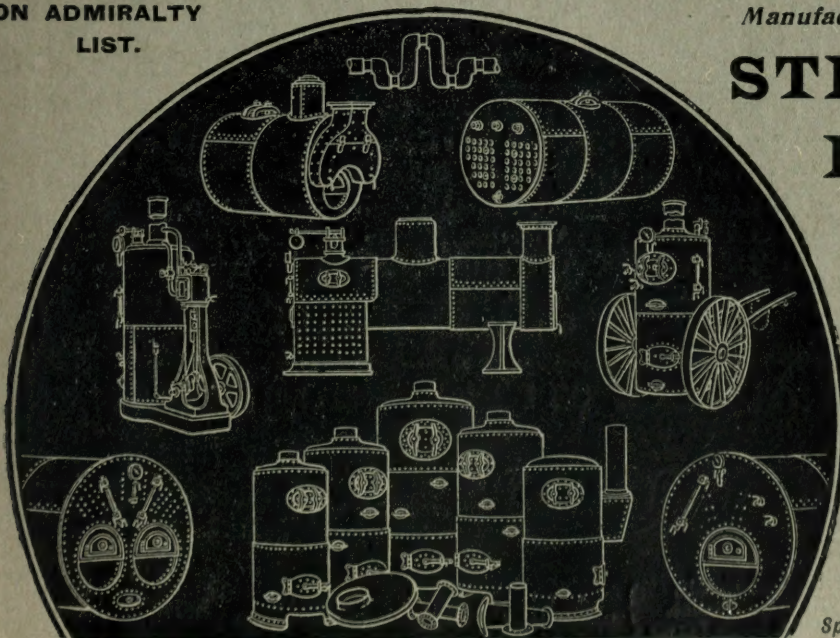
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*Manufacturers of all kinds of*

### **STEAM BOILERS,**

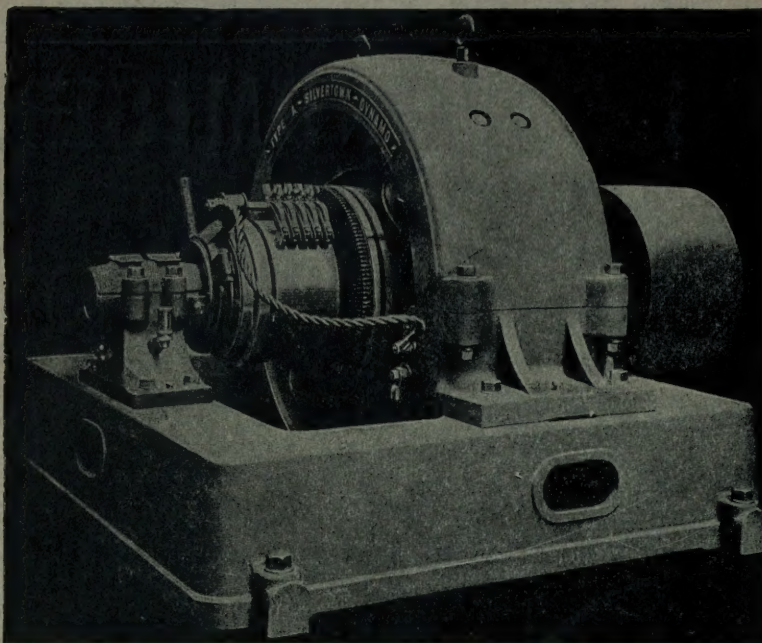
Vertical Cross-tube,  
Multitubular, Portable,  
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and "Colonial" Boilers;

ALSO MAKERS OF  
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General Steel Manufacturers,  
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Invite attention to their Unrivalled Self-hardening Steel.

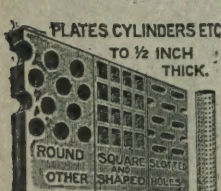
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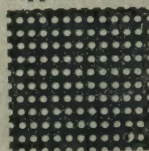
NOTE.—JAMES FAIRLEY & SONS' WORKS (Bramall Lane, Sheffield, and Mill Street Forge and Rolling Mills, Birmingham) are merely Branch Departments, and

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Perforated Metals,  
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